SEPTEMBER, 1916 15 CENTS

The Electrical Experimenter

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SATURN AND ULTRA-VIOLET LIGHT

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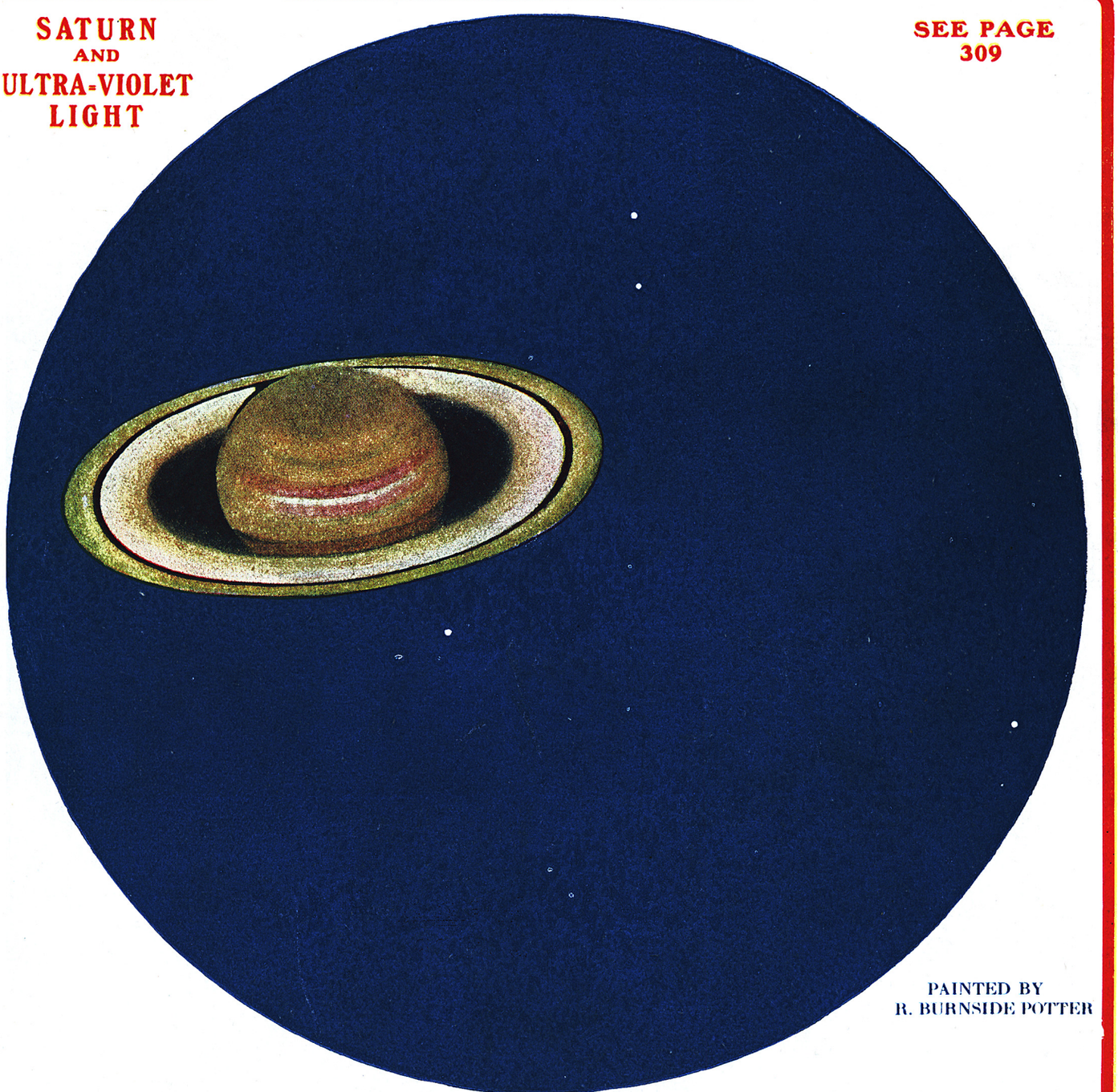

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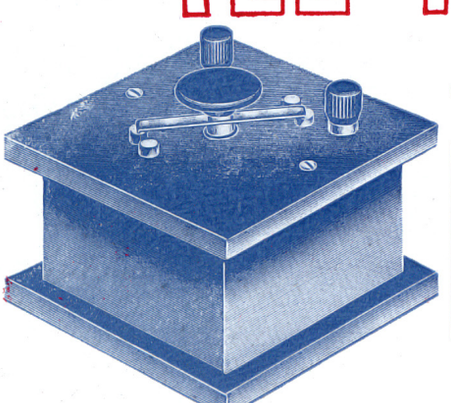

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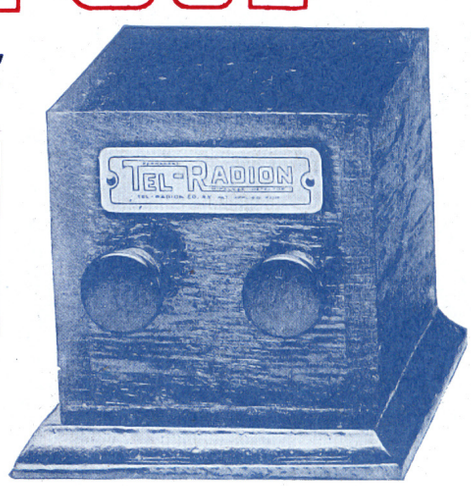

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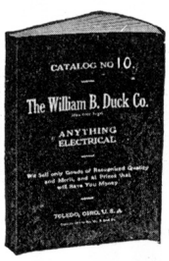

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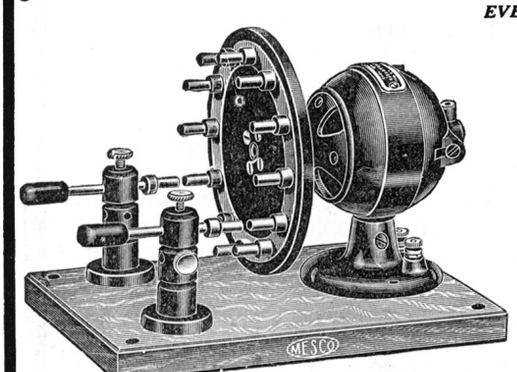

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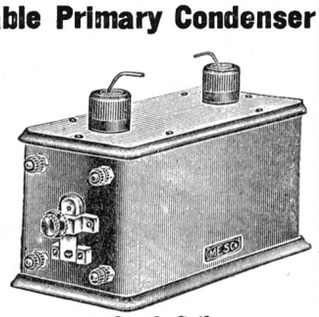

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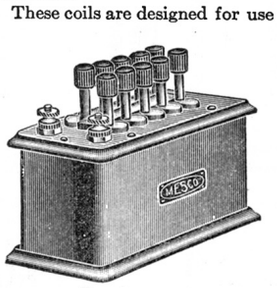

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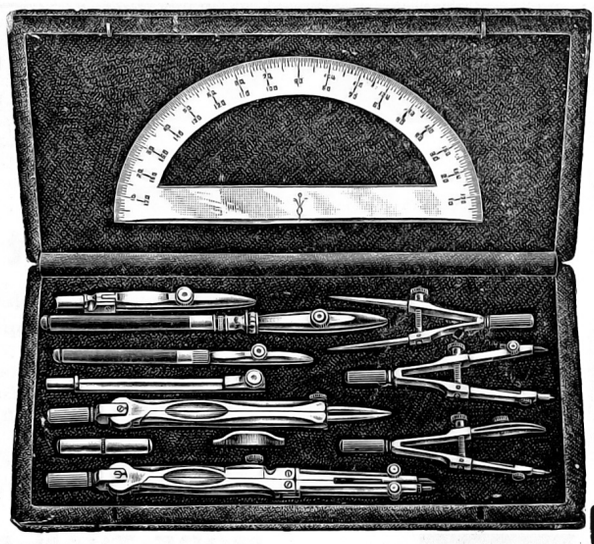

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Energy Direct from the Sun

EVERY time you switch on the electric light, every time you light the gas stove, every time you board a train, every time you eat, you are paying tribute to the sun. Whether the electricity that feeds your lamp is generated by a dynamo driven from a steam engine, which in turn obtains its energy from coal, or if the dynamo is driven by a waterfall makes little difference. The energy in both cases originally came from the sun. The coal which we burn was not always coal. Thousands of years ago plants, trees and vegetables—whole forests—were being covered by water, decaying all vegetable matter, only to sink below the ground, and to be covered with sand or earth. This vegetable matter, by various processes through the ages, finally became carbonized. This is our coal. Now, of course, the trees and plants originally were brought to life by the sun, for there could be no tree without the indirect influence of the sun. Therefore, coal is stored up solar energy. The energy we derive from waterfalls also has its origin in the sun. For, if the sun did not shine there would not be any rivers. All the waters would find their way to the oceans, there to remain. In a very few months all clouds would have given up their waters and new clouds could be formed no longer, as water does not evaporate to form clouds without heat. And it is the sun that supplies the heat. Then again, whether you eat cornflakes or beefsteak, both would soon disappear from the face of the earth, should the sun cease to shine. No vegetables can grow without the sun, and in turn no animals, which to subsist must eat vegetables and drink water.

Thus it is plain that our lives are wholly dependent upon the all-dominant sun, but we are apt to forget this important fact during our busy days and pay scant attention to this great truth. We smile a superior smile at certain savages who worship the sun, but their strange religion is at least based upon a great scientific truth, let us not forget this.

Our most efficient tungsten lamp returns to us in useful light *6-10 of one per cent* of the original energy contained in the coal. In other words, we lost 99 4-10 per cent of energy in first burning the coal, then heating the water in the boiler, which in turn generated steam and so drove the engine; the dynamo coupled to the engine then produced electrical energy, and finally the latter heated the tungsten filament to incandescence.

When we soberly contemplate this ridiculous, roundabout way of obtaining energy from the sun, the shocking fact is brought home to us into what utter childhood our knowledge of things in general is still plunged. In the past years we have heard much about "electricity *direct* from coal," which means that if an economic, practical way were found to extract electrical energy from coal without the intermediary of the wasteful steam engine, an enormous amount of power would be saved. Edison and a score of well-known scientists have worked upon the problem, but practically no headway has been made. Nor is it desirable or necessary. For, if the sun produced the energy in the coal originally, why try and extract it from the coal, which is expensive and upon which more energy must be expended in mining it?

Why not extract the energy from the sun *direct?* Elsewhere in this issue is shown an invention which, in time, may have the most far-reaching consequences. Mr. Theodore W. Case's new photo electric cell produces electricity simply by letting the sun shine on the cell; it may be said that this is the ideal way of obtaining the sun's energy. While we feel very enthusiastic about Mr. Case's invention, we must caution the over-optimistic not to expect big things at once. The new cell furnishes but a very weak and as yet an almost useless current. But a beginning has been made and a way has been shown us. It will pave the road for greater things to come.

H. GERNSBACK.

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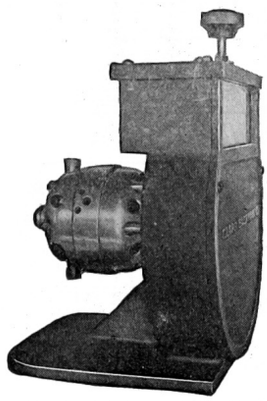

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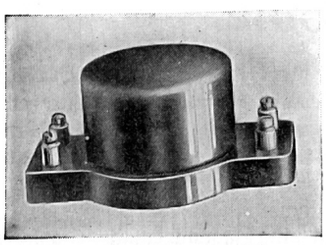

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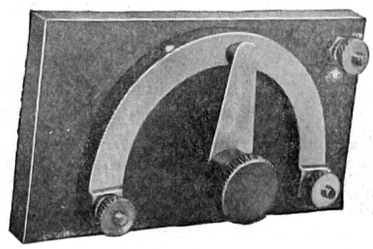

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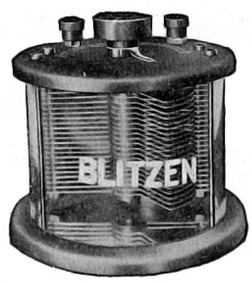

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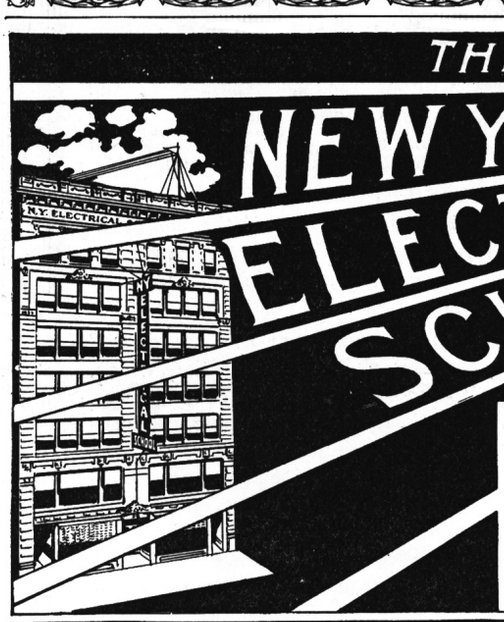

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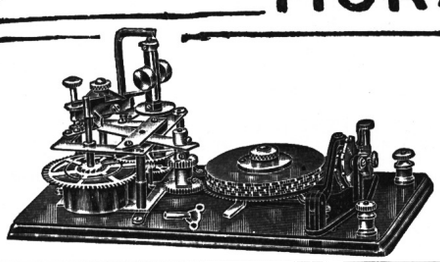

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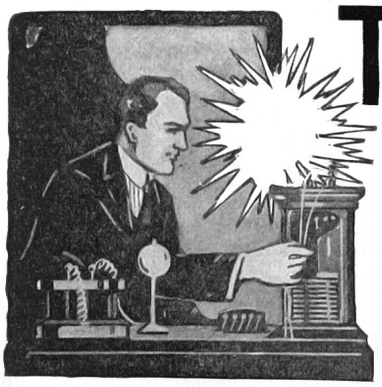


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 41 SEPTEMBER, 1916 Number 5

The Mysteries of Ultra-Violet Light

RECENT research by a small army of physicists has resulted in the presentation to this old world of a new light. As might be expected in so commercialized an age, the new light has already been put to work, while America and France, or to put it more literally, private individuals in both countries are cooperating in an endeavor to extend its industrial uses. Oddly enough, the new light is not used for illuminating purposes, except in a figurative sense, for it is invisible. To avoid becoming confused by the paradox of invisible light, it may be advisable to turn to the more familiar form of light for a starting point.

Everyone knows what light is, that is, everyone except those who have spent most of their lives trying to find out something about it. The ancients opened the proceedings by submitting proof that light was something originating in the eye which went out to the object viewed, gathered an impression and went back to the brain. One philosopher after another has settled the whole subject to his own satisfaction, only to have some later investigator prove that he knew very little about it, and often the little he thought he knew was not true. Thus, Newton showed that light consisted of exceedingly small particles of matter projected at enormous speed from luminous bodies. Huyghens, the Dutch philosopher, who lived more than two hundred years ago, maintained that light was propagated in waves in all-pervading substances which he called the "luminiferous ether." Long afterwards George Green, trying to convey an idea of the ether called it an elastic solid. Lord Kelvin, endeavoring to elucidate Green's idea, referred to the ether as a weightless jelly-like matter.

More than a century after Huyghens formulated his theory, Augustin Fresuel, a French government engineer, took it up, proved it correct and carried it further along. Still later James Clerk Maxwell, the brilliant Scottish philosopher, demonstrated conclusively that light consisted of electrical vibrat' ns. Hertz confirmed Maxwell's theory and embroidered it with interesting details.

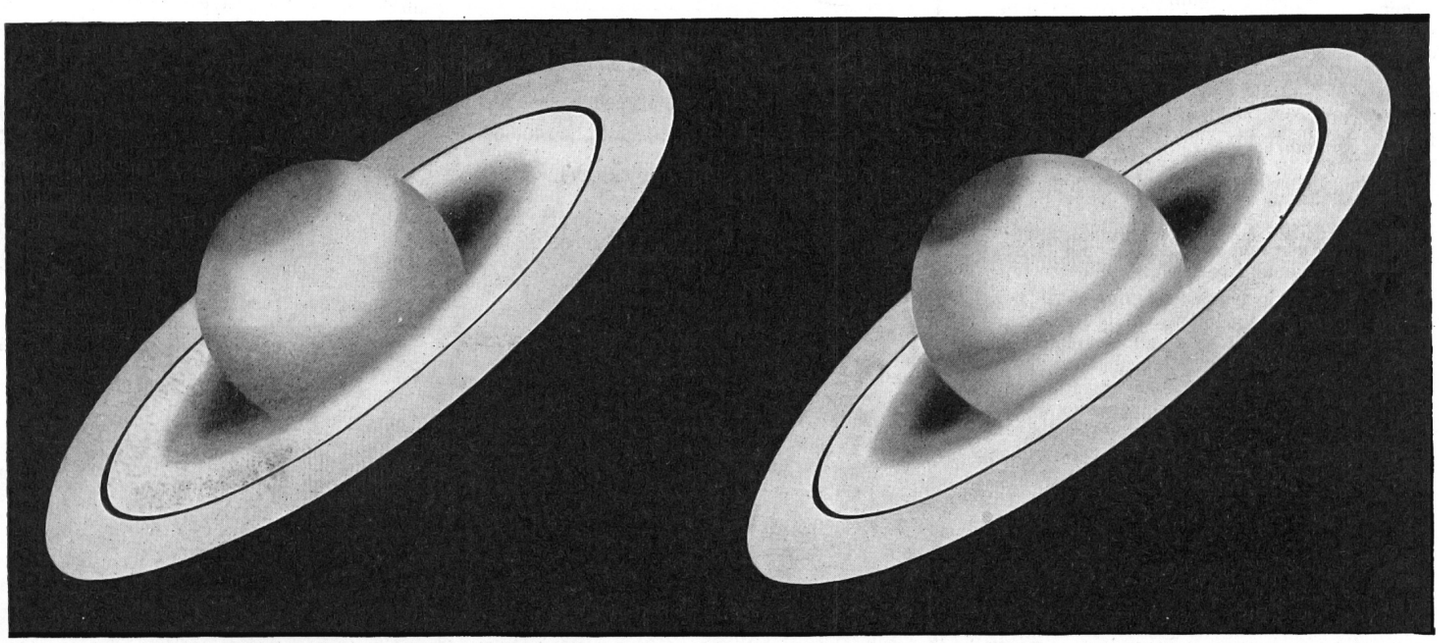
Meanwhile it is still safe to assert that light, whatever its composition, travels at the rate of 186,000 miles per second. When a wave of light is captured and dissected in a spectroscope, it is found to consist of a compound of colors ranging from red through orange, yellow, green, blue and indigo to violet. Each color travels in waves of different length, red being the longest and violet the shortest.

This rainbow-lined band, called the spectrum, embraces all of the light that is visible but includes only a part of the total. Webster would restrict the definition of "light" to that agent or force in nature by which we see. But C. P. Steinmetz, who, undoubtedly knows a great deal more about it than Webster, would have it that, "Radiation is a form of energy, the most conspicuous form of which is light." This seems to establish a basis upon which invisible radiation can claim relationship to light. In fact, the only difference between visible and invisible rays is in the length of the waves; so that if our eyes were only adapted to it, we could see by the one as well as by the other.

As it is, radiation is visible as light in a very narrow range of wave lengths, but this does not prevent the invisible radiation from being accurately studied by other means, though the eye is undoubtedly the best organ of vision yet devised.

In order to better understand what follows let us conduct the following well-known experiment:

A ray of light (coming from the sun or from an artificial light source) S is made to fall through a fine hole in the wall or door of a darkened room. This light ray will produce a small circular spot on the floor as seen at S'. We now place a glass prism, P, in the path of the light ray, as seen in the illustration, Fig. 1. We immediately observe the light spectrum, V R, which will be thrown on the white screen,



Ultra-Violet Light — Plain or Yellow Light

Fig. 5. The Planet Saturn Photographed in Ultra-Violet and in Ordinary Light. Note the Broad Belt and Large Polar Cap in the Picture on the Left Side. According to Professor Wood, This Belt Indicates an Atmosphere of Chlorine Gas or Perhaps Fine Dust.

E. The prism thus has dissolved the white ray into its component colors. At the top is seen Violet, at the bottom Red. Between these two colors there are an infinite number of other colors, but the human eye only sees seven colors.

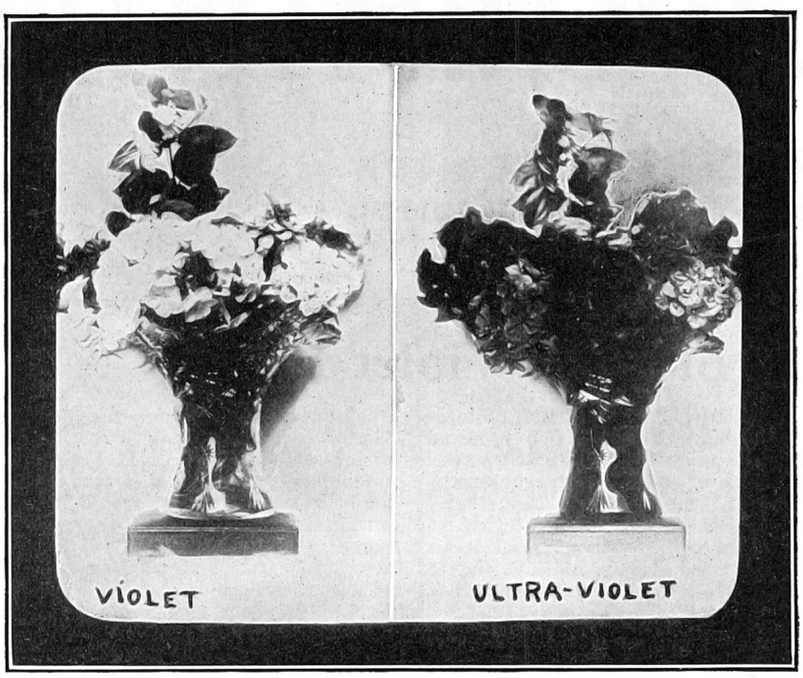


Fig. 2. A Vase of Flowers Photographed in Visible and in Invisible Light. The Contrast Is Very Marked.

Again referring to the illustration V stands for violet; I is indigo; B is blue; G is green; Y is yellow; O is orange; R is red. But beyond V and R are other colors invisible to our eyes; if we only use the proper instruments it is found that beyond the violet there is another color: the ultra-violet—a chemical light ray. Beyond the Red there is found the Infra-Red—mostly heat rays.

Ultra-violet rays are the friends of man in many ways, but they will tolerate no familiarity. To allow them to enter the eye is to invite trouble. There is no warning sense of discomfort at the time, but from six to eighteen hours after exposure, violent pains are felt in the eyes accompanied by headache. The sight is seriously impaired and it takes years to recover from the effects. Prolonged exposure to the rays may result in total blindness. Not only are these rays dangerous to the naked eye, but they are also more or less destructive to life, though in moderate amounts they have a healthful tonic effect on human beings. Sunlight, which is so stimulating to human beings, is too strong in ultra-violet light for bacteria to live in it. Sunlight is one of the best germicides known and it is by far the cheapest. No one who spends a great deal of time out-of-doors and who keeps the windows of his rooms open to allow the sunlight to get in, need worry about consumption.

Although the sun is the only natural generator of ultra-violet light, there are other means by which this light can be produced in quantity. The best apparatus devised for this is the mercury vapor lamp, especially the arc lamp when the electrodes are built of iron.

One of the most important properties of the ultra-violet light is that it will not go through ordinary glass, but it will penetrate through Quartz with ease. Professor R. W. Wood of Johns Hopkins University has employed silvered quartz for his experiments. Pure Quartz may be used as well as the vapor of bromine, which may be contained in a suitable transparent cell. Consequently pictures cannot be taken with a camera having ordinary glass lens, but must have this changed for a Quartz one.

The greatest fault with pictures taken by ultra-violet light is that details are lost, for the high and low lights are not clearly brought out. Fig. 2 shows a vase of flowers taken with both ordinary light and ultra-violet rays. Note the difference between them, the one at the right is completely killed as compared with the other. This effect is largely due to the fact that when a Quartz lens is employed for photography purposes it not only admits the ultra-violet light but all the other lights as well, making a sort of a compound image upon the plate. This great defect has been eliminated to a certain extent by employing filters for filtering out some of the colors of the unnecessary light and thereby permitting exclusively the ultra-violet light to expose the photographic plate. With the use of these filters wonderful results have been obtained.

Another very interesting property of ultra-violet light is that it will reproduce in black, marks made on paper, with Chinese white and white ink. This property is advantageously employed to expose forged checks or any document which has been changed by means of white ink. Fig. 3 depicts a photograph of a "raised" check taken by invisible rays. Note the erasure on the "Hundred" in the upper illustration. Detective agencies are constantly employing ultra-violet light for detecting such forgeries which are quite often found.

As it was stated at the beginning, ultra-violet light is an excellent germicide. Now many doctors and hospitals have installed mercury arc lamps constructed entirely of quartz for use in the production of invisible light for sterilizing purposes. A large number of these lamps are employed in the medical profession for curing different skin diseases such as ulcers, etc. The Finsen Institute of Copenhagen, Denmark, has devoted its time to curing different diseases with the aid of the ultra-violet light.

The most remarkable results, however, which are as wonderful as they were unexpected, have been obtained recently by Professor Wood.

This scientist at his summer home on Long Island investigated a number of heavenly bodies by means of these invisible rays, with astonishing results. He first photographed the moon in ultra-violet light by means of his horizontal reflecting telescope having a 56-foot focus and a 14-inch aperture.

In Dr. Wood's experiments no camera was used. The photographic plate was placed in a special frame before the lens of the giant telescope, and after it had been trained on the moon Dr. Wood moved it slowly, following the movement of the satellite until the necessary time for the exposure had elapsed. Specially prepared plates had to be used and great care was necessary during the whole photographic operation to prevent the marring of the picture by too hasty a movement of the telescope. The result is seen in Fig. 4.

Dark spots appeared on the moon's surface in ultra-violet light photographs and did not show at all in the photographs made with the visible (yellow) lights. In this respect the spots have the properties of sulphur, *and Dr. Wood has been able to conclude that there is sulphur present in the moon,* probably in rocks or other hard substances. With the agency of these wonderful rays we thus know definitely that large deposits of sulphur must exist on the surface of our satellite.

The photographs taken during the experiments are of very small size but are clear enough to bear considerable enlargement. The laboratory work which will be done with them will be performed directly from the negative, since the plates used were especially prepared for the experiments with the various lights, and the scientific value of the pictures is contained entirely in the plates and not in the prints made from them.

Professor Wood next investigated the planet Saturn. Here also a curious discov-

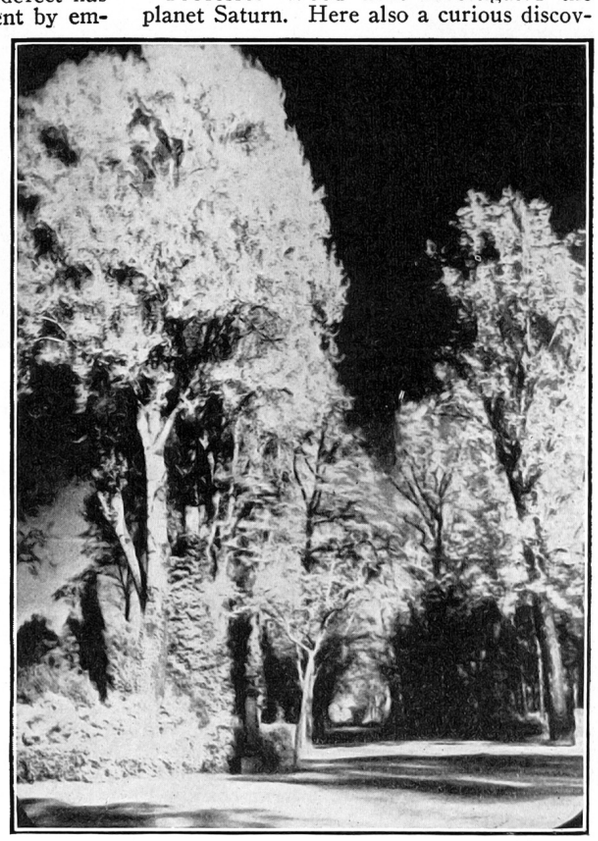


Fig. 6. Garden Scene Photographed in Infra-Red Light in Broad Day Light. Note the Pitch Black Sky and Black Shadows.

ery was made. It is portrayed in Fig. 5. This picture was made from an enlarged photograph as the original prints were too small to lend themselves to a satisfactory reproduction in this magazine.

The photographs were, of course, taken at night. The fact that there is no light from the sun falling upon the earth at that time makes no difference in the use of the ultra-violet rays, since, as the light from the planets is merely reflected sunlight all the rays that are present in the sunlight of the earth's day are to be found in the reflected light coming from the heavenly bodies.

The photograph taken of Saturn in ultra-violet light, shows a dark belt of considerable breadth about the middle of the planet. This belt was invisible in the yellow and all other rays, and therefore Dr. Wood first thought that it denotes a substance in the atmosphere of the planet which stops the ultra-violet rays. This substance he believed to be a fine dust. By dust Dr. Wood means a mist or fine fog and not dust in the ordinary sense of the word. While possible, this theory is hardly probable and Dr. Wood now is of the opinion that the belt might perhaps be chlorine gas which absorbs violet and ultra-violet light very strongly but is transparent to yellow light.

Before it can be definitely decided which of these two theories is the correct one more spectrum analyses will have to be carried on in conjunction with the photographs already made. At present Dr. Wood is rather undecided as to which theory is correct, but hopes that he may be able to prove the dust theory. However, he says that it is more than likely that the presence of the absorbing gas will be eventually demonstrated and that the dust theory will be disproved.

It is interesting to note that with all the photographs of the planets which he has taken Dr. Wood has not been able to get any that he could feel sure were representations of the surface of the bodies. The atmosphere about them all is of such depth and density that even the ultra-violet rays will not penetrate it clearly, and therefore the moon is the only body on which he has been able to analyze the surface to any extent.

In the pictures of Saturn in yellow light, one of which is reproduced in Fig. 5, there is a faint dark line around the body of the planet, for which no adequate explanation has as yet been given. A polar ring—the dark space at the top of the planet—is less pronounced and lighter in the yellow light, and no satisfactory reason for this phenomenon has as yet been worked out.

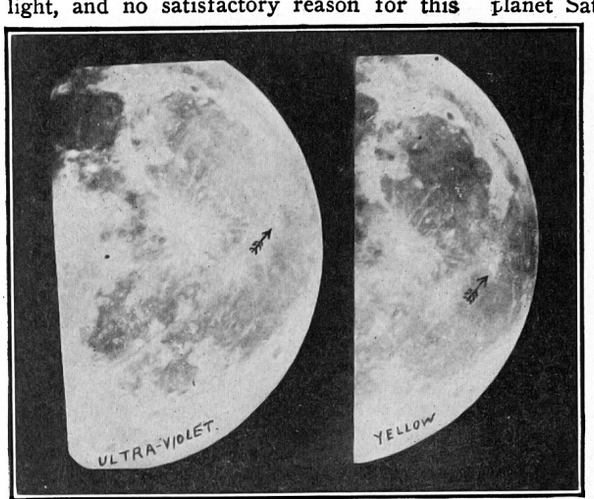


Fig. 4. Showing Section of Moon. The Original Plate, Taken by Ultra-Violet Light Shows a Spot Very Plainly, Not to Be Seen on the Other Plates. The Spot Is Thought to Indicate Sulphur

In taking the pictures, and especially in taking those in the infra-red rays, extremely long exposure had to be made, necessitating all night manipulation of the telescope, slowly following the course of the planet. Several assistants at the Mount Wilson Observatory aided Dr. Wood in his vigils.

In the photographs of Saturn the rings which are always connected with that planet in the popular mind showed up strikingly. In the case of pictures by all lights the two rings were plainly visible, the inner one light and the outer one dark.

To give the reader a good idea how the planet Saturn appears in the telescope, we reproduced it in its full colors on our front cover.

Few people realize what a strikingly beautiful object Saturn is and what a truly wondrous spectacle it presents to the eye as it floats in space, 91½ million miles distant from the earth.

Through the courtesy of Mr. R. Burnside Potter, member of the Society for Practical Astronomy, we are able to present a *true* picture of the planet Saturn. Mr. Potter, who not only is an able astronomer but a very able painter as well, graciously loaned us the painting, which is a very valuable one, and supposed to be the only one in existence.

The following is an extract from a lecture by Mr. Potter before the Society for Practical Astronomy held at Chicago, August 16, 1915:

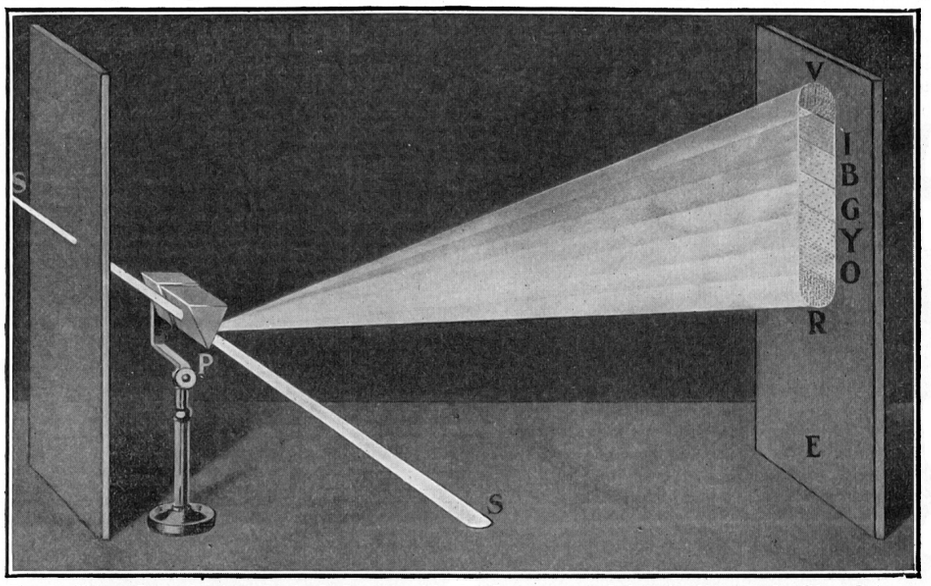


Fig. 1. How a Ray of White Light Is Dissolved in Its Component Colors by Means of a Glass Prism. The Invisible Ultra-Violet Rays Lie Beyond the Violet V, the Invisible Infra-Red Rays Are Beyond the Red R.

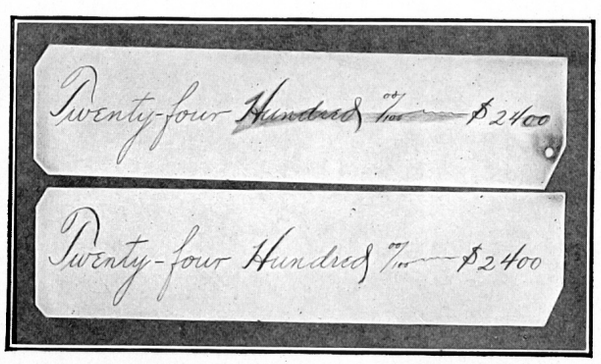


Fig. 3. Detecting Forged Checks by Means of Ultra-Violet Light The Top Picture Shows Check as Photographed in Ultra-Violet Light, the Bottom Picture in Ordinary Light.

"The painting of Saturn which is on exhibition here to-day, and which is the subject of this brief paper, was made for a special purpose, and I hope to forestall criticism by saying that it has no pretense to great scientific accuracy. It is intended to give a painter's impression of what an ordinary observer may see in an instrument of moderate size. This instrument was a sixteen-inch Newtonian reflector by Mr. Mellish. The mirrors were in perfect condition, and except for the usual slight haze on the horizon, observing conditions were as good as they ever are at my station. The view represents the planet as seen with a magnification of 580 diameters. As a matter of fact, more detail was seen with lower powers, but I used this eyepiece to make the drawing because it made the objects appear larger in proportion to the size of the field than a lower one would have done, whereas a higher power would not have permitted me to get in all the satellites. The reproduction which appears on the front cover of this magazine should be held at twenty-nine inches from the eye. This reproduction, while very successful as far as the planet itself is concerned, of course, makes the sky appear very much too light, owing to the fact that the three-color process was used. It gives a good idea, however, of how the planet looks in twilight, although I doubt if Enceladus would be visible. The colors I used, besides black and white, were rose madder, aureolin yellow and cobalt blue, and the painting was made from very careful notes and sketches at the telescope, and from a sketch in oils, half the size, worked up the next morning as soon as it was daylight.

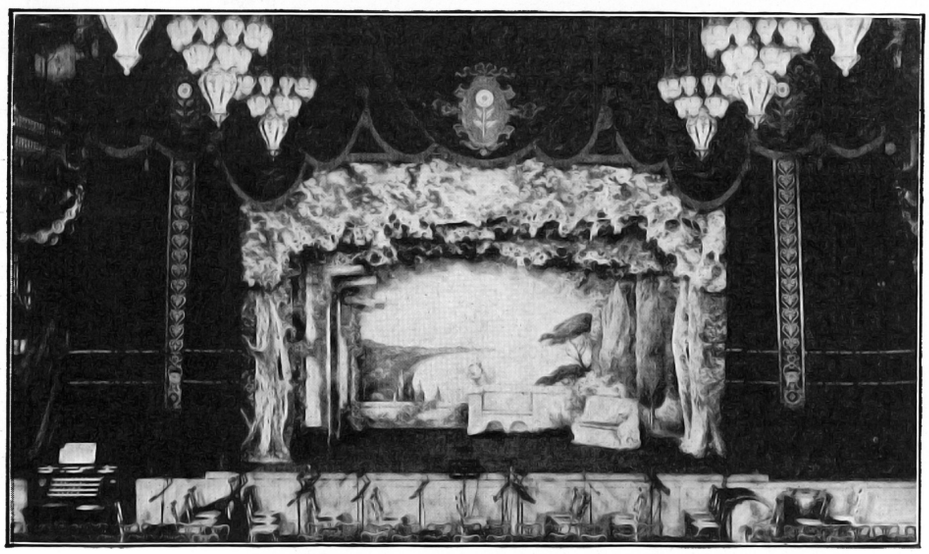
"This is the first time to my knowledge that oil color has been used to attempt exactly this sort of thing, and I do not pretend that the medium is extremely appropriate. It is a very difficult matter and requires a very steady hand to draw ellipses at this scale with a brush charged with pigment. What I wanted to show, however, was the glare which appears around all bright objects in a reflector of that size and to bring out the color of the planet and satellites, and all I can say is that my efforts in this respect were conscientious.

"The date of observation was October 21st, 1912, 2 a.m., Eastern Standard Time. The dimensions of the ball and rings were taken from Young's *General Astronomy*. The positions of the satellites were noted

(*Continued on page 362*)

Electricity, the Mystic, in Modern Hotel Service

THE hotel of our grandfather's day was usually about the size of an ordinary farm house, and the conveniences and appurtenances of our best hostelries, even of one decade ago, were truly but few in number. It is a far cry from the candle-lighted reception room of the old time tavern to the modern Twentieth Century establishment with its thousand and one novelties and luxuries with which Mine Host endeavors to please his guests.



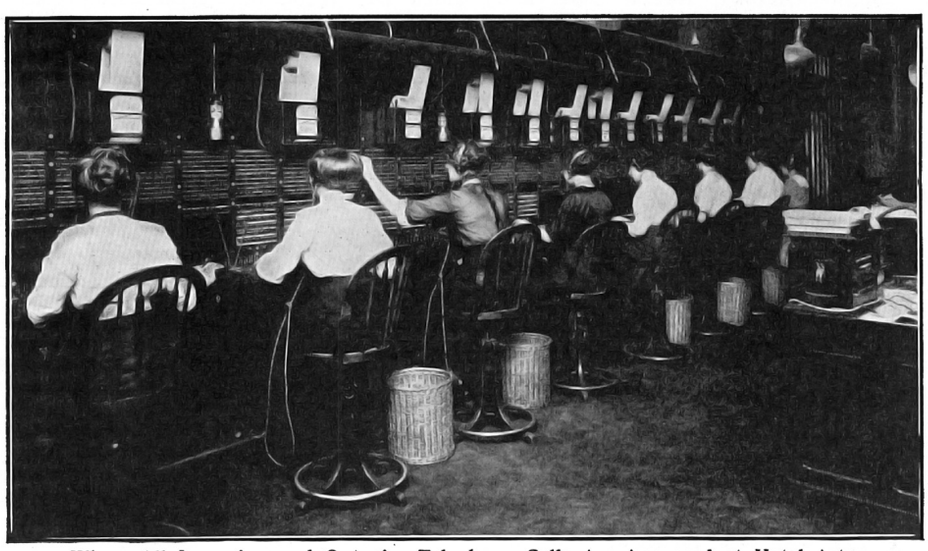
Where the Hotel Astor Entertains Banqueters; the Stage in the Grand Ball Room.

The modern battle-cry of the hotel managers nowadays is Service—first, last and always. Electricity has come to their aid in many interesting and wonderful ways, and we have endeavored to chronicle here some of the more prominent features actually in use.

To start with, most of the large hostelries in such cities as New York, Philadelphia, Chicago and San Francisco, are provided with their own electric generating plants. The plant is usually steam driven and the whole including boilers, engines and dynamos, is situated below ground. The power plant at the Hotel Astor in New York City, for instance, is rated at 1,000 kilowatts or approximately 1,350 horse-power. The electrical generating equipment comprises four 250 kilowatt, direct current generators, and the normal hotel load is carried by two of these machines, thus giving two reserve units for emergencies. This plant, like many others of similar design, is equipped with a large storage battery of 6,100 ampere-hours capacity, which is capable of carrying the entire load for several hours in case the dynamos or engines should fail, especially as no emergency connections are arranged for with the commercial electric-lighting system. Over 1,200 electric motors are used throughout this building.

Electricity performs a multitude of duties in the power plant, supplying a forced draught to the boiler fires, driving numerous pumps for water supply, filtering systems and performs dozens of other modern miracles but little known to the uninitiated.

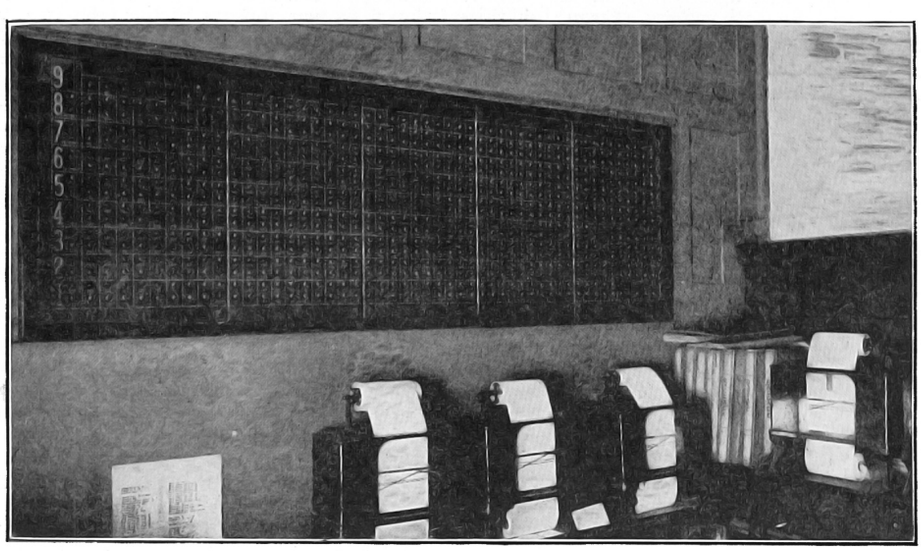
A large hotel such as this naturally requires that a good size telephone switchboard be installed, which in some instances necessitates from eight to twelve operators to handle it. This calls for a separate storage battery and motor-generator installed in the Telephone Exchange to supply the proper current for its operation.



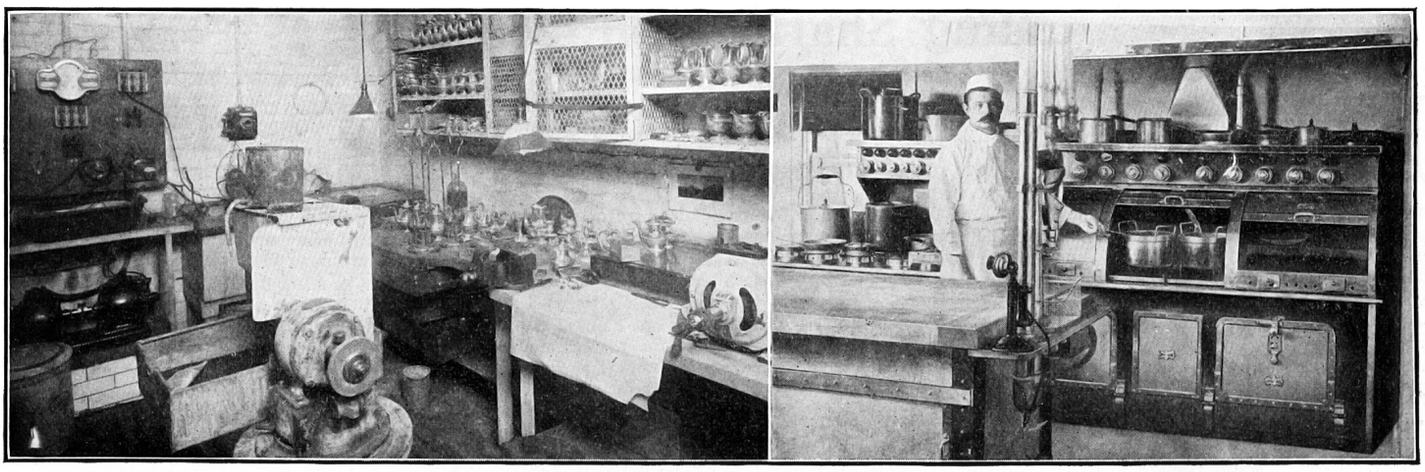
Where All Incoming and Outgoing Telephone Calls Are Answered at Hotel Astor.

Here also we find a very novel and efficient *Information System* installed. If an outside party calls up the local Telephone Exchange, and the person wanted is out of their room but thought to be somewhere about the hotel, then the telephone operator simply writes their name on the *telautograph,* a marvelous electrical writing instrument, and a reproducing machine at the Information Clerk's desk duplicates the signature.

The Information Clerk calls a page boy, who proceeds to call out the name of the party wanted as he proceeds over a certain definite route through the foyer, restaurant, lounge room, rathskellar, et cetera. If the party is found the page informs him that he is "wanted at the telephone." Stepping to the nearest telephone booth, the guest merely removes the receiver and says "Mr. Blank speaking—I am wanted at the telephone." The operator having charge of the booth telephones picks up the outside call from the house exchange operator and connects them with the proper booth. A record is kept of all such transactions which may be referred to at any time in the event of a dispute. If the party being paged cannot be found the Information Clerk writes this fact on his transmitting telautograph, which reproduces the message graphically before the proper telephone exchange operator. She accordingly informs the calling party that "Mr. Smith is not in the hotel. Do you wish to leave a message?" Possibly the reply is "Yes, have him call 'Plaza 406' upon his return." The operator writes this down on her telautograph together with the guest's name, her identification signature and the time the message was received. This message, received on the Information Clerk's telautograph, is detached and placed in the letter box bearing the guest's room number. All this takes but a few minutes and the telautograph makes a



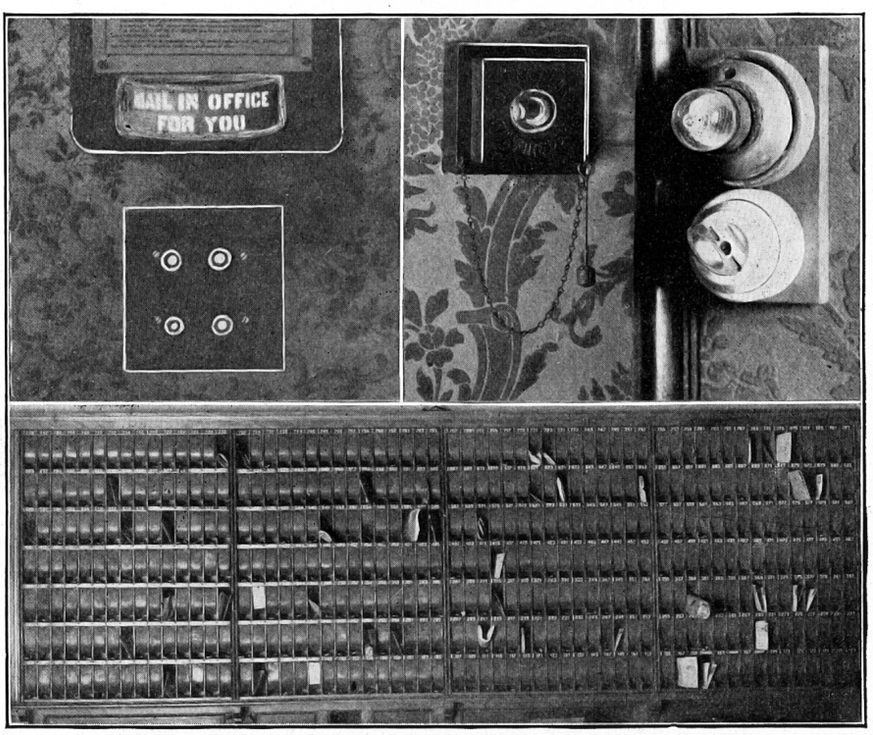
The Bell-Captain's Office, Showing Maid Signal Board and Telautographs.



At Left: a Corner of Hotel Silver Plating and Polishing Room. Right: Electric Range for Cooking.

record of all paging, leaving no room for argument. If the guest happens to be in his room of course the calling party is connected at once. Otherwise the operator says: "He does not answer in his room. Do you want him paged?"

Another extremely unique feature found at the Astor is an automatic guest's room mail signal. Behind the Front Clerk's desk there is a large, finely divided rack, each division being large enough to receive a letter edgewise. A key may be placed in a pocket corresponding to a certain room number without disturbing the delicate swinging door on the front of the mail receptacle. However, if a letter or paper is placed in it, it forces the swinging cover backward and in so doing causes an electric circuit to be closed. This lights a small electric lamp in the corresponding guest's room beneath a neat glass sign which reads: *Mail in office for you.*



Upper Half, Respectively—"Mail" Announcer in Guests' Rooms, Electric Fire Alarm and "Maid" Signal Controlled by Key. Lower Half Shows "Mail" Rack Behind Clerk's Desk. Mail Announcer Is Connected with This Rack, Working Automatically.

At the Astor there is an elaborate provision made for fire protection. Suppose a fire breaks out in your room; you have three methods of notifying the proper parties: First, you may simply remove the receiver from the telephone in your room and shout "FIRE!" into the mouthpiece. Instantly and precisely several things happen throughout the building. The telephone operator receiving your brief but important message of *one word* has noted the room number from which the call has come and informs the local Fire Captain by telautograph. The alarm signal sounds in the engine room quarters where all of the fire fighting crew are located. Two specially fast electric elevators are waiting for them at the engine room floor. In an incredibly short time after an alarm is turned in and depending upon the location of the fire, a crew can be on the job. Each man carries a piece of fire-fighting apparatus

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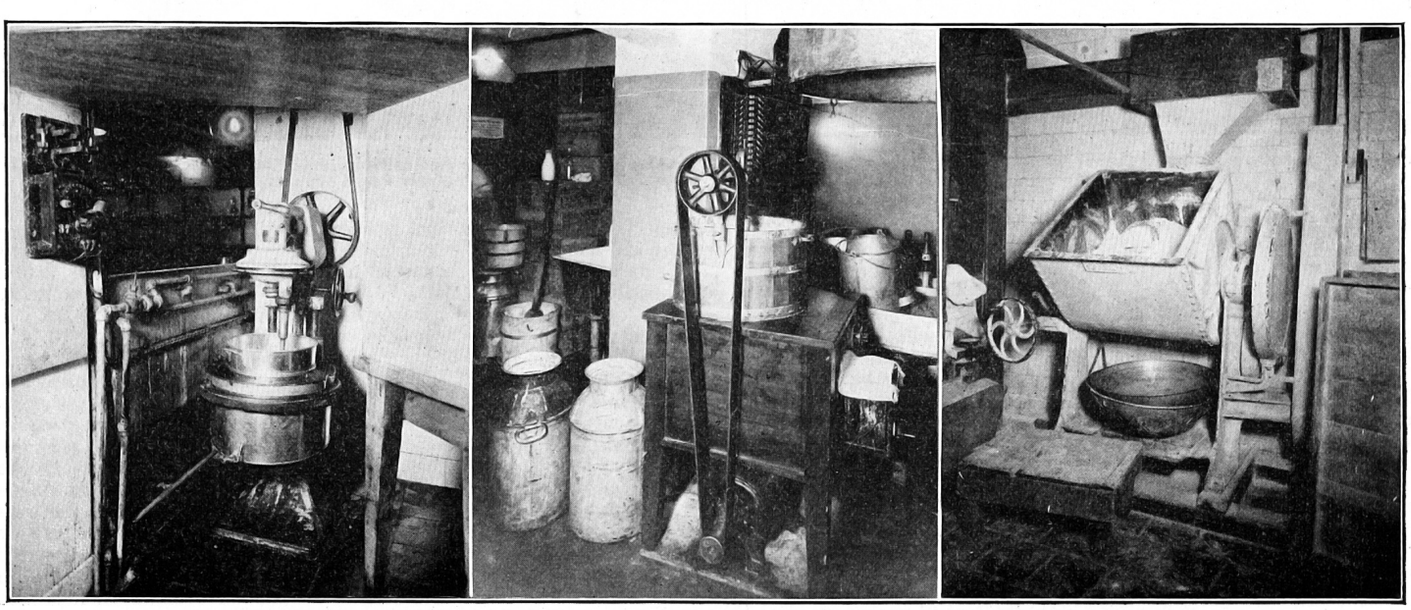

In the Cook's Domain: Left to Right—Soup Mixer, Butter Machine and Bread Mixer. All Motor Driven.

Killing Sharks by Electricity*

By H. Gernsback

NOW that the man-eating shark has solidly established himself on our North Atlantic coasts—at least for the time being—it behooves us to give the new problem our serious consideration.

No longer is his existence in our northern waters denied, for scores have been caught all along the New Jersey coast as well as in bays well inland. This was proved by the man-eating shark who killed Stanley Fisher, a young boy, but a few weeks ago in Matawan Creek, one hundred yards distant from the railroad station.

Many theories have been advanced why sharks should appear so far north, but none seem very plausible. The truth is probably found in the fact that the climate around our North Atlantic shores is changing gradually, becoming warmer little by little.

Geology teaches us that thousands of years ago Northeastern America was in the grip of the ice age—the so-called Pleistocene period. Gradually the climate changed, becoming warmer an average of one or two degrees in a thousand years. Science now knows that the maximum has not been reached as yet; it keeps on getting warmer, slowly but perceptibly. In another one or two thousand years New York will probably be enjoying a semi-tropical climate. Nature as a whole works very slowly but unceasingly and the stretch of a human life is but a fraction of a second as compared to the great time-piece of nature. Hence, we hardly can tell the almost imperceptible changes occurring all the time.

Were it not for the cold Labrador ocean current coming from the north and washing our northeastern shores, we would already be enjoying a much hotter climate than is the case at present. This is best proved by the fact that New York City is under the same latitude as the cities of Lisbon, Portugal, with an average annual temperature of 60.8 degrees; Naples, Italy, with 62½ degrees; and Pekin, China, with 54 degrees. The average yearly New York temperature is but 51.7, which is so low only because of the Labrador drift.

But as stated before the climate on our North Atlantic coast is gradually becoming warmer. This is probably the reason for the present appearance of the shark, who, as a rule, is considered a tropical or at least a semi-tropical fish. That he will come back in future years is almost a certainty; do not let us delude ourselves with the idea that his present appearance is an accident, never to occur again. Nature does not work that way.

Dynamiting a few creeks and shooting at the sharks, as well as poking boat hooks at them will not worry them greatly. If this serious evil is to be at all combated, the shark must be fought systematically as well as efficiently.

The writer has given the problem his careful consideration and herewith suggests a plan which should prove effective and which if carried out systematically may result in time in frightening the sharks away from our coasts. The writer has not patented the scheme and he gives it to the public for what it is worth. The plan is eminently feasible and not at all costly.

The illustration shows the idea in a concrete manner. On each side of a small patrol-boat, bait in form of fish or meat is hung so low that it almost touches the water level. The bait is attached to an ordinary fish hook of large size which is connected to an electrical cable insulated all the way except at the point where it makes contact with the fish hook. The insulated cable (about ⅛ inch in diameter) runs to a reel the base of which is firmly attached to the boat deck in a suitable manner as shown in illustration.

Ordinarily the bait dangles close to the boat's side. Now suppose a shark, as is his custom, raises himself from the water and snaps the bait. In doing so, the shark's weight pulls down both bait and cable, which latter immediately begins to play out from the reel. Instantly, however, the electrical current is switched on automatically, as will be seen by studying the construction of the reel in the insert of the illustration. Ordinarily, no current is fed into the bait cable, which is connected with the stationary contact breaker C, insulated

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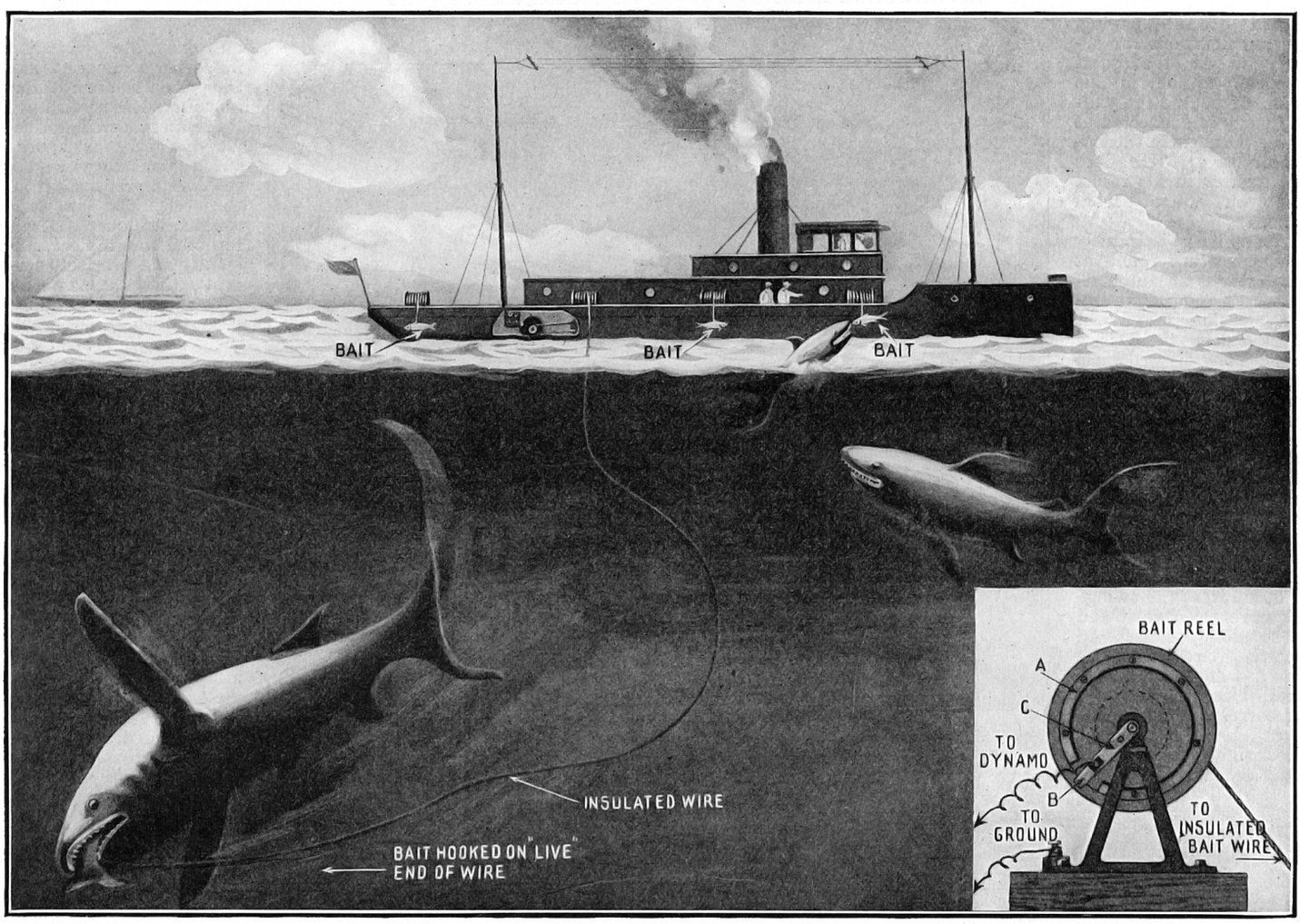


Now That There Are "Shark" Scares Daily All Along the Atlantic Seaboard, Bathers Will Undoubtedly Hail with Delight This "Electrical Shark Annihilator" Invented by Mr. H. Gernsback. Henceforth Sharks Will Oblige Us by Electrocuting Themselves.

**This article was published originally by the N.Y. "Evening World," July 19, 1916.*

The Telephone In Modern Warfare

THE signal corps in a modern army is, perhaps, the most important unit of men in the organization. Every shot made by the gun, and every move made by each soldier is practically controlled by the signal corps, that is to say, the staff officers transfer all communications from headquarters to the various posts on the fighting line by employing various kinds of signaling instruments. Some of these are familiar to our readers, as the heliograph apparatus used with the aid of the sun as a source of light, flags, lamps, telegraph and the telephone.

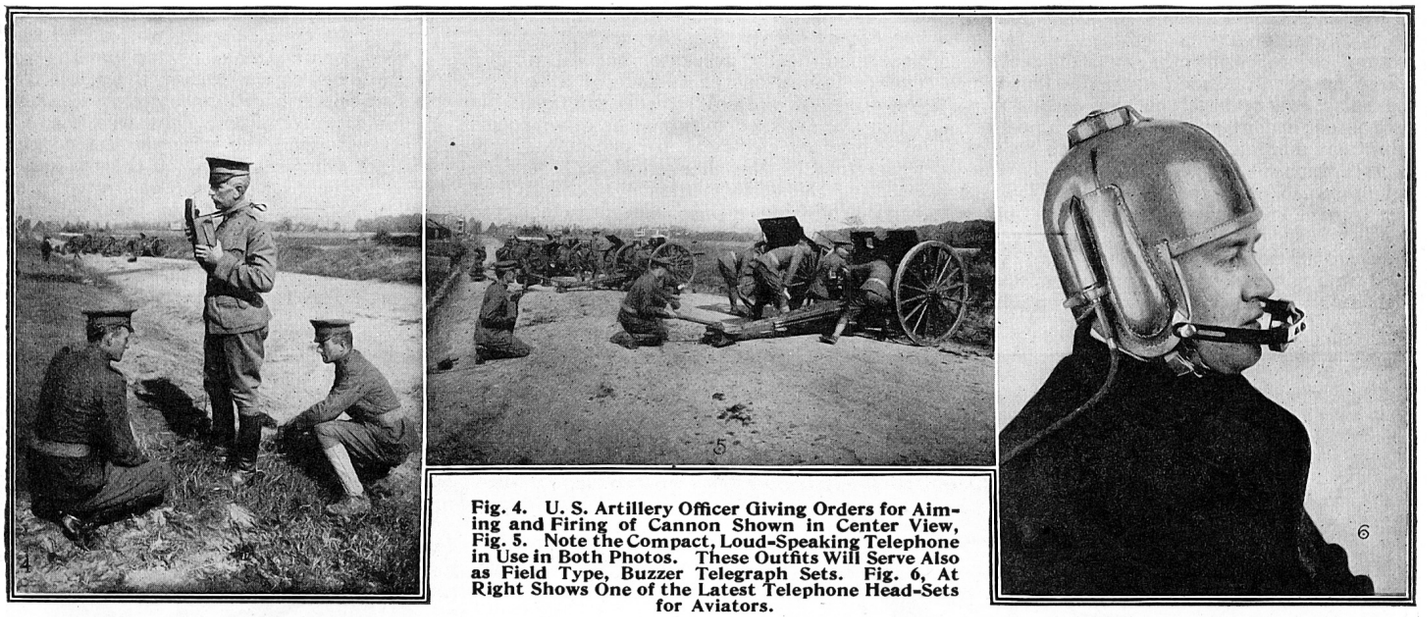


Fig. 4. U. S. Artillery Officer Giving Orders for Aiming and Firing of Cannon Shown in Center View, Fig. 5. Note the Compact, Loud-Speaking Telephone in Use in Both Photos. These Outfits Will Serve Also as Field Type, Buzzer Telegraph Sets. Fig. 6, At Right Shows One of the Latest Telephone Head-Sets for Aviators.

The telephone has been especially exploited for military work of late. In the past, this instrument was used very little, because it was not sufficiently perfected, but to-day there are several military type field telephones employed by different nations.

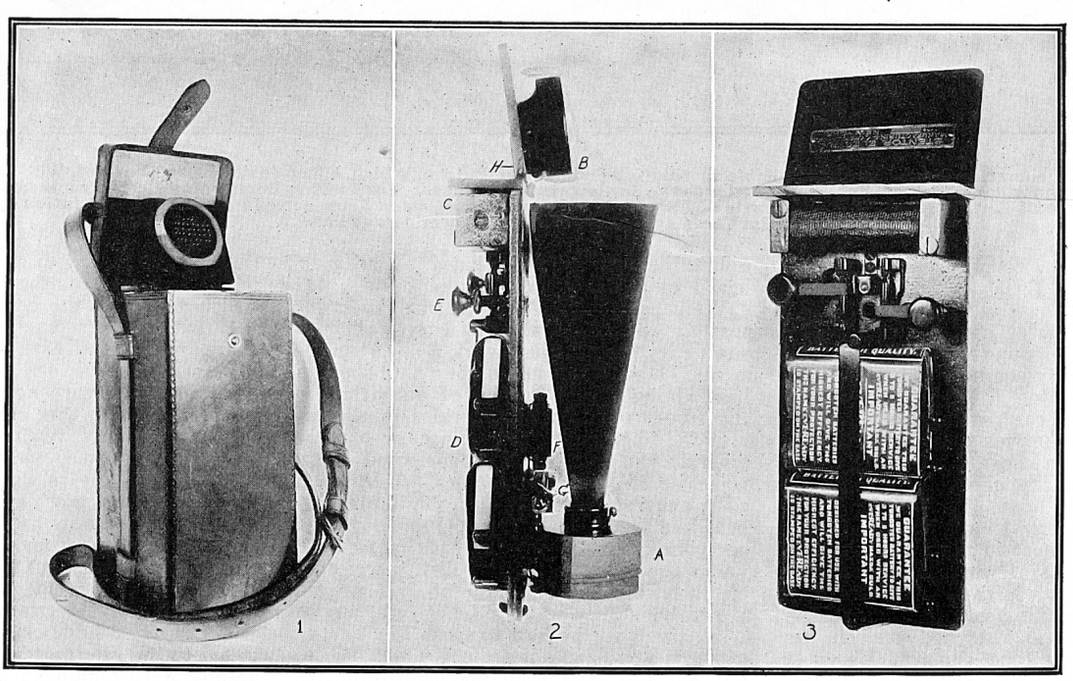
A number of concerns in this country have been developing military style telephone sets, none of which have proven superior to the portable telephone recently brought out by a New York house. The complete outfit is shown in Fig. 1. Not only is the instrument adapted for telephone service, but it also contains a military hytone, buzzer telegraph set.

This instrument consists virtually of a special loud-speaking receiver, A, enclosed in the lower compartment, Fig. 2. The horn is constructed of heavy sheet metal, substantially fastened to the receiver cap. The sound collecting instrument, or transmitter, B, is also specially built and is fastened to the case cover as the reader will perceive. The induction coil, C, is of the standard telephone type, and is supported below the cover. The power for the complete instrument is obtained from two ordinary flashlight batteries, D. These are carefully braced to the rubber support by means of a leather strap encircling both batteries. A set of four instruments comprises the complete telephone unit. The buzzer telegraph set is enclosed in the same case and supported on the same board. The buzzer, F, is of the standard high-frequency type, and is connected in series with a small telegraph key, E. This consists of two levers, one on the opposite side as can be seen in Fig. 3, which is a back view of the complete unit. The power for the buzzer telegraph is obtained from the same two flashlight batteries which supply current to the telephone. The main line consists of a rubber-covered wire, fitted at the ends with special jack plugs, similar to the ones used on a modern telephone switchboard. These plugs are fitted in a socket, Fig. 2-G, which connects the instrument with the distant party with whom communication is desired.

The cover upon which the transmitter is fastened contains two springs, H, so arranged that when it is raised to the position shown it will perform three functions: first to disconnect the telegraph key, E, from the main circuit—second, to put the telephone transmitter into the circuit so that telephonic conversation may be carried on—and third, to hold the cover in place, so that the officer using the outfit can speak into the transmitter without the inconvenience of holding the instrument in a certain position.

When telegraphic conversation is desired, the operator in charge of the apparatus plugs in with the party to whom he wants to talk, and leaves the transmitter cover down. The key circuit is thus put in operation. The telephone receiver is also connected with the buzzer circuit so that a loud sound is produced when the messages are being sent. With such an arrangement the outside noises, such as those produced by the firing of cannon, are thus overcome by the large volume of sound produced by the receiver. It has been shown by actual test that signals can be plainly read at a distance of 30 feet from the instrument during gun fire. Fig. 4 shows a United States officer of the

(Ct'd on p. 360)



Figs. 1, 2 and 3, Illustrating the Latest Military Loud-Speaking Telephone and Buzzer Telegraph Outfit. Rugged and Simple in Design and Construction. Works on Flashlight Batteries. Rising Lid Makes Connections.

Electricity Direct from Sunlight

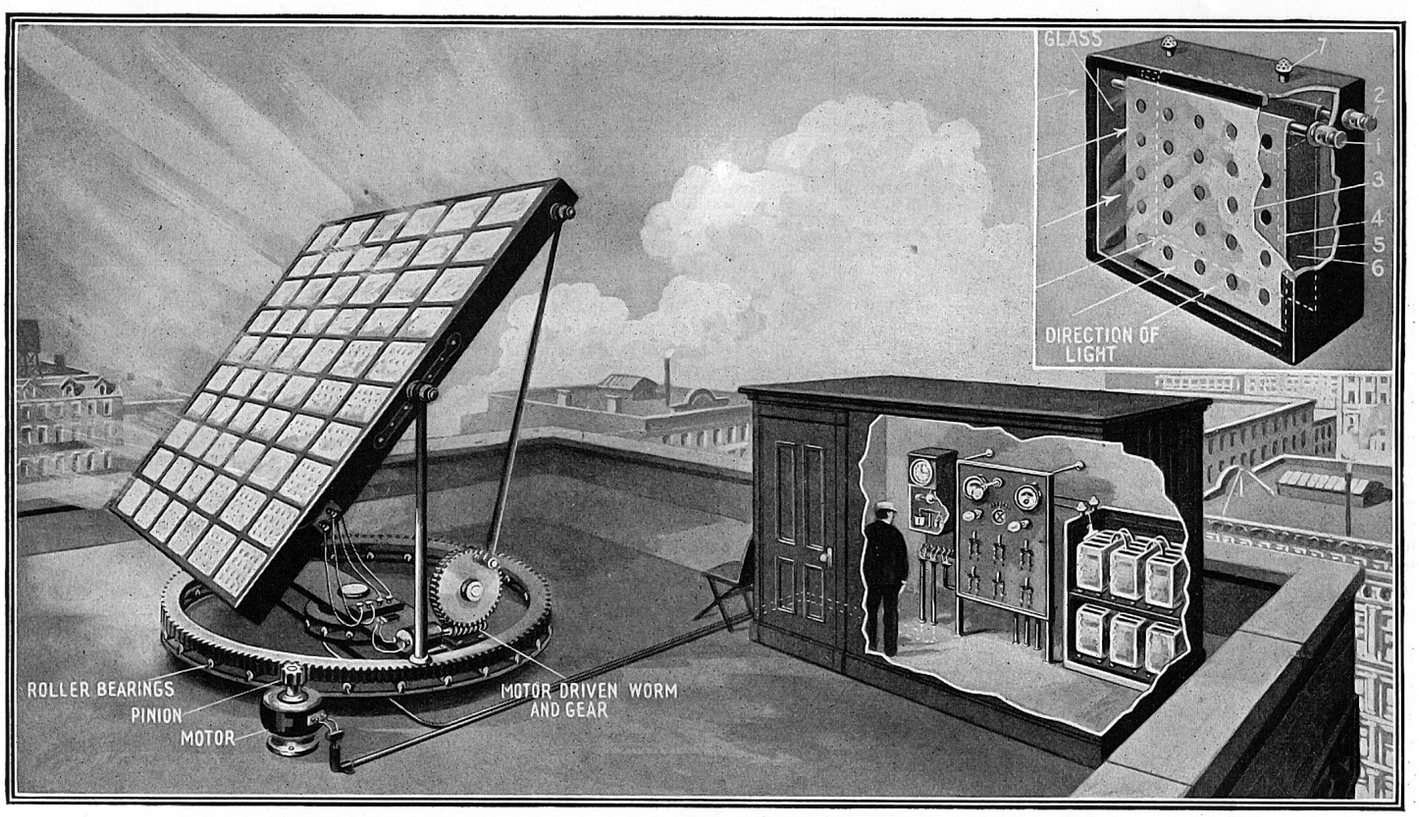
EVERYTIME you walk, sit, or stand in the sunshine for one minute, you are unconsciously the recipient of about one and two-thirds horsepower in solar energy. In watts this is equivalent to 1,246 enough to light approximately twenty-five 50-watt tungsten lamps. Again this amount of energy might turn a motor-driven churn, ice-cream freezer or a dozen other useful devices. These figures are based upon the fact that the solar energy reaching the earth's surface is equivalent to 5,539 foot pounds per minute at midday, for every square foot of surface exposed to the light. This is equivalent to .167 horsepower or 124.58 watts per square foot per minute. In other words when you think it is a hot day and the perspiration is streaming down your face, it really is *hot!* For every square inch or a spot on your head but little larger than a postage stamp there is being received .0494 B.T.U. (British Thermal Unit) per minute, and *one* of these B.T.U.'s represent enough heat energy to raise the temperature of 1 pound of pure water 1 degree Fahrenheit at or near the maximum density of the water.

Such being the case, it is small wonder that a straw hat proves a god-send to us poor mortals who must, perchance, stroll in the sunlight during the summer months. The top of your head, if uncovered, will receive solar energy to the value of 3.96 B.T.U.; sufficient heat to raise the temperature of 3.96 pounds of water 1 degree Fahrenheit. The active solar area of the average person approximates 10 square feet. Thus when you lie stretched out on the beach, Old Sol will be shooting his rays at you to the tune of 71.20 B.T.U.'s a minute. This means that every square inch of the body exposed to the sun's rays receives potentially an amount of energy of something like .86 watt per minute. This means one candlepower of light figuring on the new gas filled tungsten lamp as a basis.

These astounding facts may seem somewhat alarming to some of us and the question naturally arises—what becomes of all this energy and the resultant heat? True, we feel the heat on a sultry summer day, but not all of it. The figures cited above are scientifically accurate, but all of the energy falling on the surface of a body in the form of radiant light is not available when transformed into heat or other forms of energy, as electrical, for example. Only a fraction of the theoretical solar energy reaching the earth's surface is effective as work-producing power, due principally to heat radiation and other factors. The hair of the head, for instance, helps to dissipate the energy of the sun's rays, one answer to the query—I heard it coming—why didn't the Indians wear hats? Who ever heard of a bald-headed Indian?

Well, as we have just learned it is not possible to utilize all the energy in the sun's rays for practical work-a-day requirements. However, some of our philosophers have thought well enough of our friend—the sun—to bend their energies in the direction of perfecting a device or scheme whereby man may be emancipated from some of his earthly troubles. Imagine a solar generator resembling a miniature hotbed, like those you sprout plants in, placed on your roof or in the back yard, and under the glass, instead of dirt, a series of electrolytic cells, the whole affair arranged to revolve slowly so as to be at right angles at all times to the sun's rays. The energy in these rays, including those which we do not see, has thus been applied to the direct production of electricity by Mr. Theodore W. Case and recently described by him before the New York Electrical Society. In the first experiments a small cork was wound with copper wire, the coils not touching, and between these coils was wound a silver wire, coated with silver bromide, but not in contact with the other wire. The two terminals of the wires were connected with a pair of sensitive high resistance wireless 'phones. The cork, supporting the coils of wire, was placed under a very small stream of tap water, which was allowed to run over it, the whole forming an electric cell or battery. A strong beam of intermittent light was then concentrated upon the wire on the cork. A distinct note was heard on the wireless receiver, due to a current generated in this cell of copper and silver bromide in tap water. It was then decided to try shielding the silver bromide wire on the cork from the light, leaving only the copper wire exposed. The result was most surprising in that the note was distinctly heard on the receivers, due to the intermittent light which fell upon the cell. Again, however, the note would sometimes be heard and sometimes not. Next, the copper wire on the cork was shielded from the light, the silver bromide wire now being exposed to the light. With this experiment no sound was heard under any conditions. The result then indicated, without doubt, that the reaction was due to the effect of light on the copper wire, and that the silver bromide electrode acted only as the other electrode, being of no importance in other respects.

A new cell was then made by winding the cork with two copper wires, opposed to each other, as electrodes, under the tap water. When both copper wires were exposed to the intermittent light, naturally no results were obtained; but, upon shielding one of the copper wires from the light a note was again heard in the receivers. The conclusion was then reached that the cop-



A Solar-Electric Generating Plant May Be Available in the Not-Far-Distant Future, Which, When Installed on the Roof, Will Cause Light-Active Cells to Rotate and Align Themselves at Right Angles to the Sun's Rays at all Times. The Electric Energy May Be Stored in Storage Batteries So As to Be Available at Night. Insert Detail of Single Cell Shows Two Copper Plates, 4 and 5, Immersed In a Salt Water Solution 6; 3 Is Glass, While Gas Vents Appear at 7. Electric Terminals at 1 and 2.

per wire, under the influence of the intermittent light, must be producing the current. But, as before, this arrangement would work at times, and not at others. It was then found that this was due to the fact that some parts of the copper wire used were oxidized and other parts were not. One of the copper wires was then thoroughly cleaned with fine emery paper and the other copper wire was highly oxidized in a Bunsen flame before being wound on the cork. With this construction the notes on the telephone were far louder than before.

As soon as it was found that the copper oxide electrode was the one that had been reacting, a larger cell was constructed, consisting of two copper plates, instead of wires, both plates, oxidized in a flame, immersed in tap water and placed one back of the other, with light shining on the front plate. This cell was connected to a galvanometer of 200 ohms resistance. The back plate, or the one shielded from the light, acted as the zinc plate in an ordinary battery. Sodium chloride (common table salt) was put into the water to reduce the internal resistance, and a much stronger current was produced. In bright sunlight, a deflection of 45° to 50° was noted. When the light was thrown on what was formerly the back plate, the previously exposed front plate would, while in the dark, act as the zinc. In other words the plate in the dark always acts as the zinc.

Several larger cells were then constructed 4"x3" in round glass jars, one plate placed back of the other; the front plate burned in a flame to copper oxide until the surface was black, and the back plate polished copper. The glass cells were then placed in wooden boxes, excluding all light, with a door opening in front. Some of these cells were tested for over three months, and they seemed to react as well at the finish as in the beginning.

Next the action of polished copper plates, not oxidized, was tried in the salt solution, under the influence of light. The plate exposed to the light gradually, during fifteen to twenty minutes, changed to a reddish color; then quickly to a very dark purple, and finally, to a grayish black. This cell was then tried with a galvanometer and found in its reaction similar to the above cells in which the front plates were oxidized in the flame, except that the reaction was very much weaker; and, so far, no better results than 4 or 5 degrees on the galvanometer have been obtained. The back plate acts as the zinc, and the cell is in every way, except in intensity of reaction, similar to the cells which have oxidized plates. The polished copper plates do not turn this dark purple except under the influence of light. However, polished copper immersed in a salt solution will turn a reddish tint in the dark, which was taken to be copper oxide; then, if exposed to light, will turn to dark purple, which is assumed to be a higher oxide. Only when this cell is short-circuited does the back plate undergo a marked change of appearance; it then grows darker in color, although it always remains of a much lighter shade than the front plate which is being exposed to light.

To return to the cell in which the front plate is oxidized in a flame and the back plate is polished copper, some of its peculiarities proved very interesting. If left short-circuited in the dark while not in use, the efficiency of the light reaction is greater upon exposure than when left open-circuited while not in use. Upon exposure of the front plate to light the reaction is practically instantaneous. However, after the rapid upward swing of the needle, there is a continuous slow upward swing, lasting a few seconds, before the complete swing is reached. If the light be left on for a short time, fatigue is noticeable. This, at present, cannot be explained, but it may be due to the absorption of gases. In this fatigue, however, the galvanometer needle only drops a few degrees and then seems to remain there. If the cell be rested in the dark, recovery is then evident upon again exposing the cell to light.

If light be cut off from the cell, the needle drops quickly for a few degrees only. Assume the reading to be 40° on the galvanometer when first exposed to the light; then the light be shut off, the needle wil drop to 15° almost instantly; but from 15° to zero, it will drop slowly, due to some after effect. The needle will finally come to zero within two or three minutes; then, in most cells, will reverse three or four degrees; then come to zero and remain there. The reversibility in the dark, after exposure, seems to depend upon the strength of the sodium chloride (salt) solution, for zero is reached almost instantly in a very dense solution, but much more slowly, as above described, in weaker solutions.

HARNESSING the sun's energy is by no means a new idea. Many scientists all over the world have for years worked on this fascinating problem. Do you know that on a clear, sunshiny day, the sun's rays beat down on every square inch of your head with enough energy to light a one candle-power, nitrogen filled, tungsten lamp? This and many other interesting facts are described in this article. The new photo-electric cell recently invented by Mr. T. W. Case should, therefore, prove of more than passing interest. While the current obtained is rather weak, Mr. Case has opened a new field to us which may soon prove commercially practical.

THE ELECTRICAL EXPERIMENTER FOR OCTOBER.

A brilliant array of important articles which you should not fail to read will appear in the October number of THE ELECTRICAL EXPERIMENTER. *The editors would particularly recommend that all students of electrical subjects follow our serial articles on Experimental Chemistry and Marvels of Modern Physics. We can assure them that these specially prepared treatments of these respective subjects will contain valuable hints and facts not touched upon in the average school courses. And the older folks—they will find in each succeeding issue an ever-growing amount of practical and popular scientific articles. We shall endeavor to please all. In the next number:*

"The Wireless Girl."

"How the Indians Heard the Great White Father via Wireless," by W H. Kirwin, 9XE.

"When the Engineers Go to War—a Military Aspect."

"Electrical Frauds—What they Are and How to Avoid Them."

"New French Electrical and Radio Apparatus—With Some Wonderful Photos"—by our Paris Correspondent.

"Recent American Radio Apparatus."

Start of a Serial on "Wireless Sending and Receiving Instruments—Just How They Work and Why."

"A New Design for a Chromic Acid Battery," by C. A. Oldroyd.

"A Home-made Lathe for the Amateur," by Alfonso Bolognesi.

"High Frequency Apparata and Experiments," by Hubert A. McIlvaine.

The output of the cell depends upon the strength of the salt solution. The weaker the solution, up to a certain point, the better the results. For instance: 1.005 Beaumé specific gravity of electrolyte gives the best result. A cell 3"x4" gives 1/10 of a volt in sunlight and about 1/2000 of an ampere. Upon increasing the strength of the salt solution the amperes increase, as would be expected in lessening the internal resistance of the cell; but the voltage drops quickly.

An interesting fact, noted later, shows that when the electrodes are covered with several coats of white paint, or bath enamel, the cell acts; indicating that perhaps some of the invisible rays are also effective. If heavily coated, however, no action ensues. Passing the light through water, however, the cutting off the heat rays, made no appreciable difference in the voltage or current.

Regarding the intensity of light, it was found that ordinary diffused daylight works extremely well on this cell. For instance: with the same galvanometer, on a cloudy day with diffused light, 10° reading was noted on opening the door of the cell; whereas, intense sunlight gave 40° to 50°, a difference in reading which was only four or five times as great as compared to the much greater intensity of sunlight over the diffused daylight on a cloudy day.

Next, in regard to the voltage in different intensities of light. The voltage will stand at a higher point in intense light when being drawn upon, than it will when being drawn upon in a lower intensity of light. However, if the cell be exposed at a very low intensity of light, without being drawn upon, the voltage will rise to nearly as high a point as in intense sunlight; but when being drawn upon, it takes a higher intensity of light to hold the voltage higher.

The amperes, of course, are increased with the area of the plates, providing the plates are evenly oxidized and evenly exposed. Otherwise, local currents will be set up.

Better results are obtained if the back of the exposed plate be heavily painted or enameled, or insulated in some way; so that no local action will occur between the front of the exposed plate and its back.

If several cells be connected in series the voltage increases; and if several of the cells be connected in multiple, the amperes increase. This is what would be indicated in any theory.

When these cells are newly made, if they are left in the dark, say over night, before being used, the cells will act much better the next morning than when first made and will continue to do so thereafter.

During experiments conducted in Florida with some of these photoelectric cells a voltage of 1/10 and an amperage of 2/10 was obtained. It was found best to heavily coat the back of the front plate with some non-conducting material, also the front plate is preferably perforated with a number of small holes to lower the internal resistance of the cell as shown in

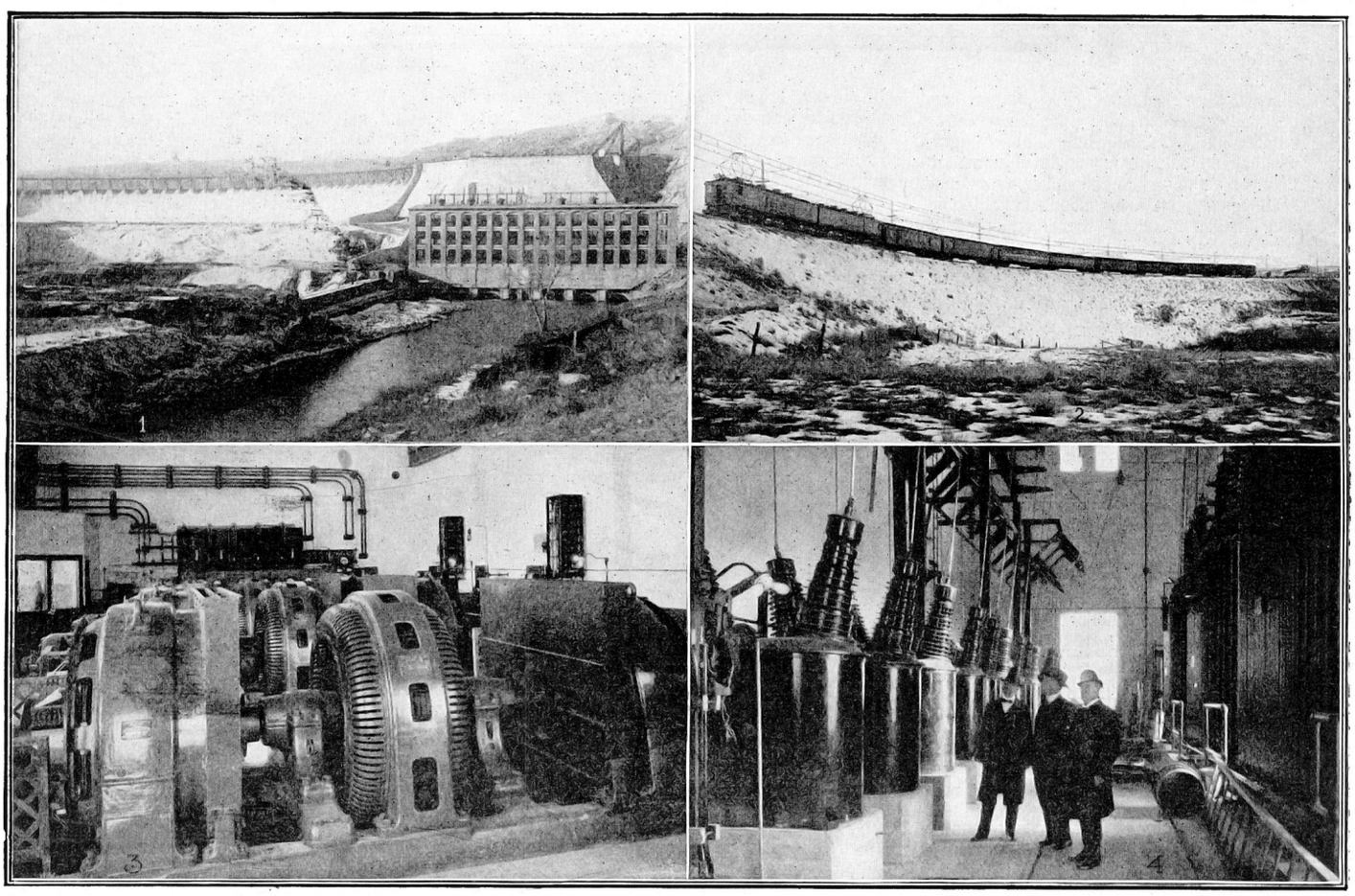
(*Continued on page 370*)

The Dawn of Electrical Railroading

IT is not so many years ago since the good people of Pennsylvania were completely flabbergasted by the sight of a steam locomotive as it wended its way at a snail's pace through the valleys of Quakerland. Its progress was, at all events, slow and tortuous and there was a slight risk of exceeding State or municipal speed laws, for this early prototype of the modern Goliath of the rails did not proceed at a more astonishing velocity than four miles per hour. This speed is on par with that of the average pedestrian, as is well known, and it is really nothing short of marvelous to contemplate for one moment the broad strides attained in modern railroading. Luxurious Pullmans and sleepers now roll across the one time wild and uninhabited prairie, and on across the towering Rockies to the Pacific Coast.

This wonderful development is pictured in the accompanying views, Figs. 1 to 4, which show to some extent the mighty machinery and forces of nature brought into play in working out this stupendous undertaking. All those who have traveled even to a slight extent on steam driven railroad trains, have undoubtedly been annoyed during the summer months by the ashes, smoke and gas wafted back through the open windows of the speeding train, and appreciate fully the immeasurable advantages accruing from the use of electrical energy in driving trains. Besides, the electrical method is, in every way more efficient, both from the economical and operating standpoint and the point of flexibility of control and distribution.

This wonderful electrified transportation system passes through some of the most in some of the most isolated sections of the country. The 100,000 volt transmission lines feed the sub-stations and in each the current is passed through massive oil switches and step-down transformers (see Fig. 4), in which operation the potential of the electrical energy is reduced to 2,300 volts A.C. The current from the transformers, after being reduced as just mentioned, passes through the proper control apparatus and switches to the motor-generator sets. These motor-generators, of which there are from two to three in every sub-station, comprise a 60-cycle synchronous A.C. motor, driving two direct current generators, each of which develops 1,500 volts D.C. The two D.C. machines are permanently connected in series, thus delivering a direct current potential of 3,000 volts, which is said to be the highest



Views Along Newly Electrified Chicago, Milwaukee and St. Paul Railway Running from Avery, Idaho, Over the Great Continental Divide to Harlowton, Mont., a Distance of 440 Miles. The Electric Power is Transmitted Over the Route at a Pressure of 100,000 Volts. The Locomotives Are the Most Powerful Ever Built as They Have to Climb Mountain Grades

It has taken electricity many years in its efforts to supersede the steam-driven monster that to-day spirits us homeward or vacation bound for distances of a thousand miles or more. In the past ten years, however, electrical railway engineering has developed with rapid strides, and a number of the more progressive and up to date railroads have given this form of power a thorough trial. Very few railroads which have tried it out properly have so far discarded it. One of the latest railroad electrifications over mountainous country, and a credit to the engineers who built it, is that vast trackage owned by the Chicago, Milwaukee and St. Paul Railway, stretching from Avery, Idaho, over the great Continental Divide to Harlowton, Mont., a distance of 440 miles.

gorgeous scenery on the Continent and every luxury is assured travelers in the superb trans-continental all-steel flyers which traverse this system under the names of the *Olympian* and the *Columbian*.

In Fig. 1 there is shown the mighty dam erected at Great Falls, Mont., where high pressure water turbines are installed to drive powerful alternating current generators, which deliver thousands of electrical horse power of energy at a pressure of 100,000 volts. Along the electrified system there are distributed fourteen sub-stations, each of which, complete, costs about $160,000. Each sub-station is about thirty-three miles from its neighbor. The railroad company has built substantial and artistic living quarters for the sub-station employees, who live along the railroad lines

direct current potential ever adopted for railroad work in the world. The interior of one of the sub-stations is shown in Fig. 3. The synchronous alternating current motor is mounted mid-way on a common bed-plate, while the two D.C. generators are rigidly secured on either end of the central shaft. Thus all three machines on the common bed-plate are driven at a constant speed and operate with the maximum mechanical and electrical efficiency.

The 3,000 volt direct current, after it leaves the sub-station switches, passes along the trolley cables, suspended over the track. It is led through specially designed pantagraph trolleys on the roofs of the locomotives, as the reader will perceive in Fig. 2 The electric locomotive shown in this fig-

(*Continued on page 370*)

Why Not Have the President Talk Simultaneously to "All the People?"

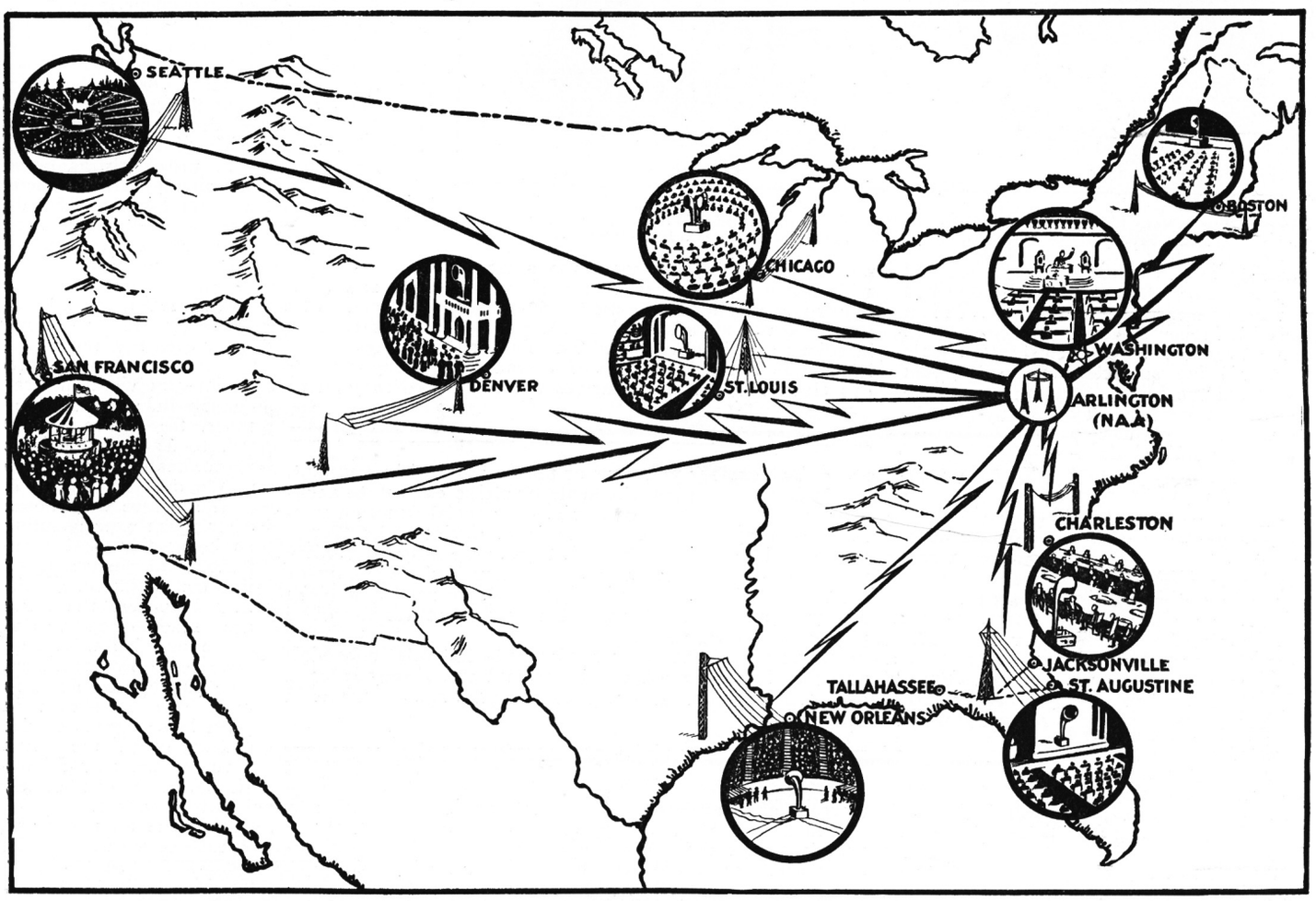
SSH.....h!!! "All ye, The People of the United States: his Excellency, the PRESIDENT!" This greeting may be heard all over the country, in the not-far-distant future, and not on a phonograph either, if Mr. Paul Calhoun's dream comes true. His idea is to link up all the larger cities and towns by radio with the powerful transcontinental government wireless station at Arlington, near Washington, so that when the President makes a speech before Congress or even his inaugural address, *all the people* can hear it, instead of a select few gathered within ordinary hearing distance of the speaker as has been the case in the past.

Such a scheme as this does not belong wholly to the realm of idle dreams and the practical applications and tests already made with long distance radio-telephony from the powerful Arlington station controlled by the government, have proven that a man's voice can be flung afar, through the all-pervading ether from Washington to Honolulu, 4,900 miles. So, if such an idea as the one outlined here, is to be put into effect it would seem a not very difficult matter to ensure its emphatic success.

In the radio telephonic tests conducted a few months ago, the wirelessly transmitted voice waves were caught on an antenna in the usual way and then transformed into pulsating electric currents, which passed over the regular wire circuit several miles long. Thus it has been found practical to transfer the spoken voice from a standard telephone circuit through a wireless station, across great distances by etheric waves, and back again into undulating electric currents passing over a metallic wire circuit.

As the illustration shows, it would be possible to have the President make his speech in the usual way in the Capitol at Washington, and have the voice waves picked up by a battery of sensitive microphones, located at the speaker's desk. These would proceed to transform the voice vibrations into undulating electric currents, passing over a wire circuit to the radio station at Arlington. Here, by means of a sensitive vacuum tube control as used in the last memorable radio-telephonic test, the voice waves in the form of fluctuating electric currents of ordinary amplitude, would be amplified in power and propagated from the great antenna of the Arlington station with the power of several hundred horses. These oscillations would fly through space at a velocity of 186,000 miles per second, and thus would take but the fraction of a second to traverse the intervening space between Washington and San Francisco, or Honolulu, for that matter.

As our artist has endeavored to show, the President's speech as received by radio in all the large cities throughout the country would be amplified if necessary through the apparatus, provided with large horns, so that an entire theater audience could hear the words distinctly. The receiving apparatus could be placed outside of public buildings, too, when desired. Not only would it be possible for those in such privileged locations to hear the President's words, but all amateur radio stations, of which there are many thousands throughout the country, could receive the message as well. Undoubtedly this plan will be tried out in the near future. It would seem a very patriotic and inspiring idea to carry this out during the next presidential inauguration exercises at Washington, in March, 1917.



A Remarkable Yet Perfectly Feasible Scheme Recently Suggested Whereby the President's Speeches May Be Heard Simultaneously All Over the United States. The Voice Waves at Washington Are Flashed by Radio from Arlington, Picked Up by Radio Receptors and Amplified so That a Large Audience Can Hear Every Word.

ELECTROLYTIC IRON FROM CAST IRON.

According to *The Electrician*, a certain French foundry is now producing tubes and sheets of electrolytic iron by a process in which ordinary cast iron serves as a base, while the product consists of iron in a very pure state. The cathode rotates in a solution of ferrous salt so as to have a layer of iron deposited on the surface. The solution is kept neutral by placing iron turnings in the bottom of the tank and by adding oxide of iron as a depolarizer. The iron thus produced is very hard at first, and contains some gas; it is then annealed in order to expel the gas and produces a soft, malleable metal. Iron pipe can be made directly by using a rod as a core, but the manufacture of sheet iron is not yet in a commercial state, though they expect to produce, without rolling, sheets of very soft and pure iron which will be very valuable for electrical machinery.

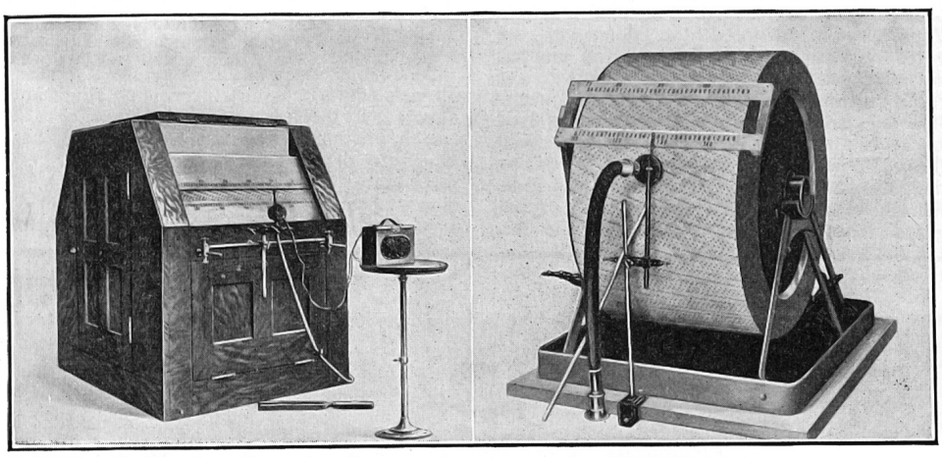
Of the 13,000,000,000 kilowatt-hours recorded 70 per cent. of all the central-station energy of the country is being generated by a few companies, representing a saving of approximately 15,000,000 tons of coal.

Timing the Frequency of Musical and Vocal Sounds

PROBABLY and quite possibly you sing or play a musical instrument. All well and good, but do you run the scale or strike each note accurately? To ascertain whether you do or not is the special function performed by the latest triumph in scientific musical devices—the Tonoscope—a really wonderful instrument that indicates visually just what note you are singing or playing and the exact vibration frequency of that particular note. Read how Prof. Carl E. Seashore settled a pitch discrepancy argument in a symphony orchestra as to whether the oboe or French horn player was off the key.

Also how a certain vocal soloist had a tendency to flat relatively high notes. The Tonoscope demonstrated the error and the singer learned to correct the note. The instrument seems to possess superior merit in psychological research.

IN experimental psychology, instruments have as a rule been designed to meet immediate needs, and have usually been described incidentally in reporting the results of psychological investigations. Much research has been wasted because done with untried apparatus. In fact most of our instruments are in a crude condition; and many fields of investigation lie untouched for want of measuring instruments. It is a sign of a higher stage in the science that the most essential psychological instruments are now being subjected to investigation apart from the specific pending psychological use. Only in this way can we properly develop instruments and standardize the technique of manipulation, writes Prof. Carl E. Seashore, in *The Psychological Monographs.*



Simply Sing a Note Before the Mouthpiece of the "Tonoscope" and It Will Indicate Visually the Exact Frequency of the Note. It Is Also Applicable to Musical Instruments.

The tonoscope, one of the latest important acquisitions of science, works on the principle of stroboscopic vision, the principle of moving pictures. Auditory vibrations of air, caused by voice or musical instrument, are converted directly and instantaneously into visual configurations on a screen, and the *vibration frequency* which denotes the pitch of the tone may be seen in plain figures on a scale. This enables us to measure the pitch of any tone by direct inspection while singing, speaking, or playing under normal conditions. The ability to do this opens up countless problems in the psychology of tonal expression.

In moving pictures it is well known that, if we have successive pictures which are alike thrown on the screen in the same place and in rapid succession, they form one continuous picture which stands out clear and still. This is the principle here employed. The revolving screen, rotating at the rate of one revolution per second, carries rows of dots, regularly spaced but varying in number for each row. When a tone is sounded, the row which has the dot-frequency that corresponds to the vibration-frequency of the tone will stand still and be clear while all other dots move and tend to blur. Each row runs under a number on the scale. The row which stands still, therefore, points to a number which designates the pitch of the tone. The screen contains a sufficient number of rows of dots, varying in number, to correspond directly, or by multiple, to all tones within the range of the voice. To see the pitch of the tone one has therefore only to see the number of the line that stands still.

The essential features making up the Tonoscope in turn are the speed regulation, the screen, the dot grouping, the sensitive light and sound transmitter, and the siren.

The validity of stroboscopic frequency measurements depends upon the accuracy with which the movement of the exposed object is controlled. The method employed in the early models proved entirely too laborious and inconvenient. The final solution was found in the use of a synchonous electric motor which drives the drum (screen) at a regulated and constant speed.

A motor of this type is mounted on the main shaft of the tonoscope drum. The drum, serving as a balance wheel and being connected to the motor by a coil spring, furnishes the right degree of inertia and flexibility in the transfer of the pull.

A large 10 v.d. tuning fork is used as an interrupter. It is energized by primary cells, and is encased in a box which is kept out of the way in a closet so that no noise shall come from it. A 16 c.p. lamp used for resistance in the motor circuit, is mounted between the prongs of the fork and proves a convenient means of keeping it at a sufficiently constant temperature, the temperature being that to which the fork is raised by the heat of the lamp within the box.

A 110 volt direct current is completed through the motor and a mercury contact interrupted by the fork. The current is reduced by the lamp resistance. The make-and-break is short-circuited with a condenser to avoid forming of an arc. A large amplitude of the fork, fully 10 mm., also helps in preventing the tendency to arc.

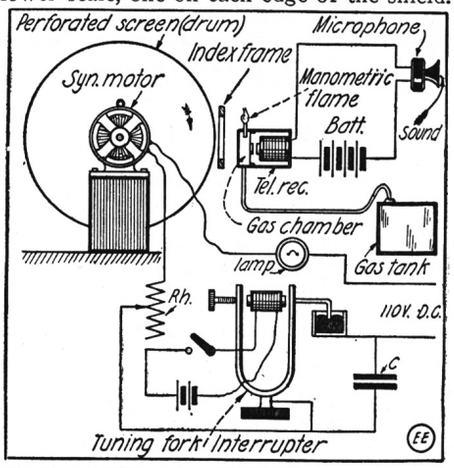
A rheostat inside the tonoscope case, with a switch on the surface, serves for the adjustment of current, as there may be fluctuations in the supply main. A small detachable crank for starting fits the end of the main shaft which comes out flush with the edge of the case on the side. To start the tonoscope one has only to start the fork, give the drum a turn up to approximately one revolution per second and close the switch. Once started, the instrument will run indefinitely and there is no care or distraction in the running of it.

The rotary stroboscopic screen is formed by mounting a sheet of aluminum in the shape of a large drum over a heavy balance wheel. A section of this drum is seen through the opening on the front of the case. (See Figure.) This screen is 50 cm. wide and has a circumference of 242 cm. The balance wheel is heavily mounted on ball-bearings resting on a heavy iron frame. The whole instrument is enclosed in an oak case with doors on every side.

The size of the drum is determined by the minimum area for the legible distribution of 18,500 markings, or stroboscopic dots. In the present screen the dots are bored holes, three and one-half mm. in diameter. The inside of the drum being dark, the holes show up clearly as black spots on the light aluminum surface. These holes are spaced with the highest mechanical accuracy and are arranged in 110 parallel rows, each completing the circumference of the drum in uniform spacings for each row (Cf. arrangement of dots in screen in cut). One row has 110 dots and the dot frequency in the remaining rows increases by one dot for each row up to and including 219. Thus we get frequencies to correspond to each integral vibration frequency in an octave of tones, the octave of 110 v.d. to 220 v.d. This is approximately from *A* up to the *a* below middle *é*.

This octave was chosen after much experimenting as being the most serviceable, all factors taken into consideration. Within this octave the tones are read directly, and above and below it they are read by multiples. The number of holes in each row is shown in plain large figures on the scale. When the drum revolves the row formation stands out clearly and each row points to a number.

As may be seen there is an upper and lower scale, one on each edge of the shield.



Details of "Tonoscope" Mechanism, Including Tuning Fork Interrupter for Synchronous Driving Motor.

It is necessary that the holes should be large enough to be easily legible under the

(*Continued on page 371*)

MICHAEL FARADAY.

September Marks His 125th Birthday Anniversary.

Born Sept. 22, 1791—Died Aug. 25, 1867.

Michael Faraday was born September 22, 1791, at Newington Butts, near London, England. His father was a blacksmith. Faraday when quite young, began to learn the trade of bookbinding, at which he worked until he was about twenty-two years old. He studied there, with the greatest interest, all the books he could obtain, especially books dealing with chemistry and physics. Those book undoubtedly awakened his interest in electricity.

Later he heard of the great invention of Sir Humphrey Davy, and went to London to hear a lecture delivered by Davy, before the Royal Institution of London, on his arc light. When introduced to Davy, in 1831, he at once employed Faraday as an assistant in his laboratory. He then threw himself with great energy into the study of physics and chemistry, and after a short time became Davy's secretary.

In the year 1827 he was made professor of chemistry of the Royal Institution in London, and from the year 1829 to 1842 he was also employed as a teacher in the Academy of Woolwich. He died August 25, 1867, at Hampton Courts.

Faraday, to whom we are indebted for the discovery of electro-magnetic induction, and a great many other far-reaching elec-

Michael Faraday, Discoverer of Electro-Magnetic Induction. One of the World's Most Famous Electricians.

trical inventions, was one of the world's greatest scientists. As for his original inventions, his genius has never been surpassed by any living scientist.

It must be remembered that practically all of the important electrical appliances, which to-day are almost necessary to our life, have been developed from Faraday's discoveries. Telegraphy, telephony, all regulating mechanisms and the dynamo, are all due to Faraday's wonderful research work on electro-magnetic induction.

The discovery of the electro-magnetic induction was not due to luck or chance, but was the result of logical reasoning. Already Ampère's theory seemed to indicate the existence of such a phenomenon. However, Ampère, notwithstanding his great keenness in deduction, was not able to advise the proper means of demonstrating it. Faraday, himself, as early as the year 1825, tried to perfect a device which would produce current in a circuit which was not connected to any source of current; but not until 1831 was he able to prove his theories. The form in which the effect was found, was altogether different from what the scientist had thought or expected.

He found that the moment a circuit was closed a momentary current in an opposite direction would be produced in an adjacent wire. This, however, was sufficient for Faraday to deduce the problem within a very short time. Even the induction due to the residual magnetism did not remain hidden from his keen insight.

THE X-RAY IN MODERN INDUSTRY.

After the discovery of the properties of the X-Ray by Professor Röntgen, people realized the importance of these rays for therapeutic and medical work. However, as time passed, different scientific workers experimenting with these rays found other wonderful uses aside from the medical ones. Lately they have been harnessed in modern industry, for the study of the properties of materials, says the *Edison Monthly*.

A very interesting experiment was made recently by one of the largest electrical companies in this country. A steel casting was received which was two and one-half inches thick, and which weighed about one ton. During the process of machining down to the desired thickness, slight imperfections were disclosed. It was then decided to make an X-Ray examination of the entire casting.

The steel was set on edge, backed by a sheet of lead, with a photographic plate between. A Coolidge X-Ray tube especially designed to carry high voltages was used. Current at 1.25 milli-amperes was passed through the tube with a two minutes' exposure. The resulting picture located a long flaw. To confirm the X-Ray diagnosis a disc was cut from the metal at a point indicated in Fig. 1, and the hole was found as shown.

In another test, copper castings were examined. Ordinarily copper castings are full of pores and blow holes, which not only reduce the mechanical value of the metal, but result in very low electrical conductivity. This, of course, is due to the oxidization of the metal when cast. Boron suboxide, a by-product of the manufacture of boron, has the property of deoxidizing copper without combining it, and is now generally used in all copper plants. In the test boronized coppers were examined side by side, the X-Ray photographs being recorded on the same plate. The pores in the unboronized metal showed clearly, while the treated metal showed a solid structure.

X-Rays are being extensively used by cigar manufacturers in killing the tobacco beetle larvae, a small insect living on the leaf of the tobacco plant, and if allowed to live it becomes developed, and eats its way through the finished cigar. These little insects are now being destroyed by exposing the finished cigars, which are packed in boxes, to the X-Rays, without affecting the quality of the tobacco.

These penetrative rays are also being used by naturalists in studying the structure of different vegetations and flowers, during development of the plants. Fig. 2 illustrates a flower radiographed; note the developed structure of the flower and the fine fibrous frame about the flower and leaves. Every vein of the leaf is clearly shown.

Various metals and precious stones are of late being studied with the aid of the X-Rays. These wonderful rays have, perhaps, performed more serviceable duty to mankind, than any other ray known, with, of course, the exception of our solar rays. Undoubtedly many more uses for the X-Ray will be discovered in the near future.

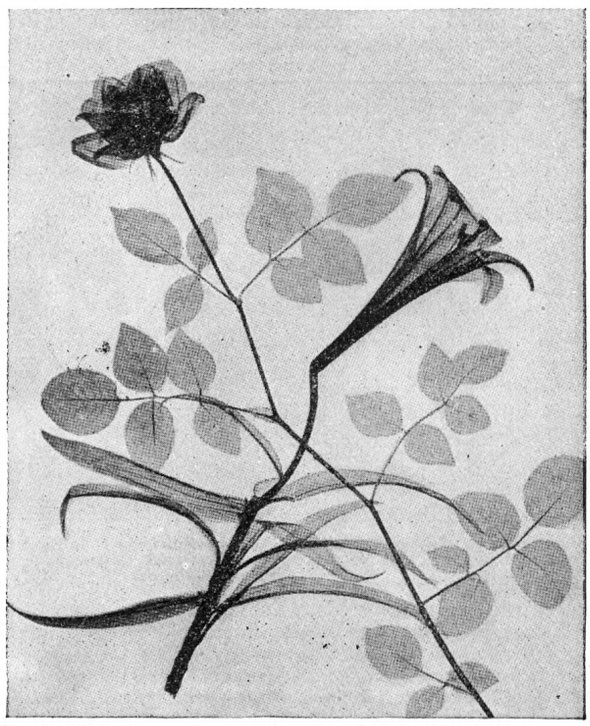


Fig. 2. This Flower Radiograph Was Made by Mr. W. H. Dodge of Chicago. Note How the X-Ray Has Brought Out the Fine Fibrous Frame about the Flower and Leaves.

CANADA TO EQUIP PARKS WITH RADIO SERVICE.

Philip E. Edelman, of St. Paul, Minn., has been engaged by the Canadian government as electrical engineer to prepare plans for wireless telephony and telegraphy installations to secure communications in the extensive Dominion Parks of Western Canada. The installation will be the first of its kind and a new application of radio-communication. The equipment will be of new design specially adapted for the difficult mountain service. The purpose of the installation is to prevent forest fires and game trespassing by affording a means for instantly reporting and calling for aid. The territory embraces some 7,000 square miles, where ordinary means are out of the question for purpose of communication.

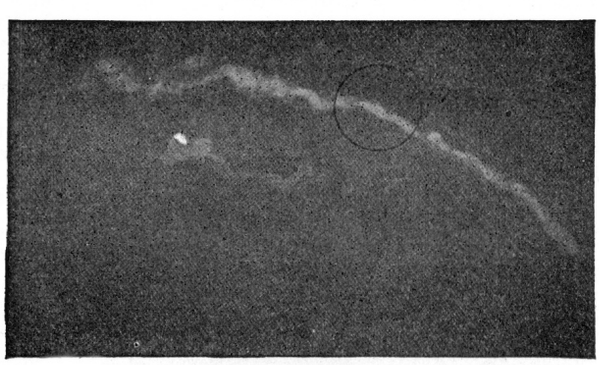


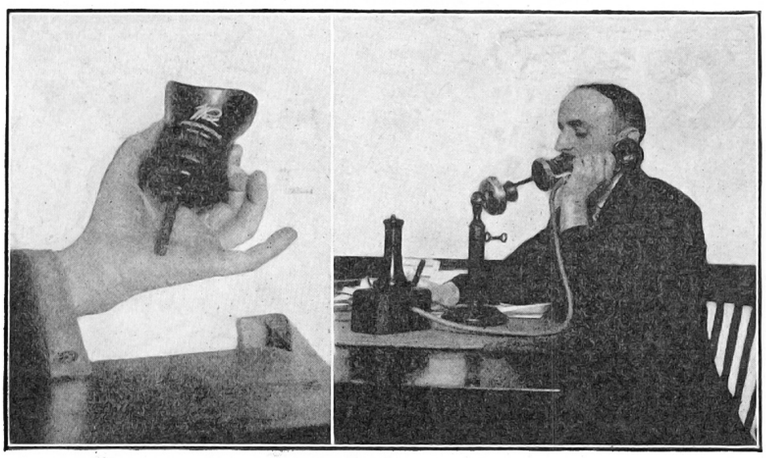
Fig. 1. An X-Ray Photograph of a One-Ton Steel Casting Disclosed the Serious Flaw or Hole Marked by the Circle.

USE OF ELECTRICITY IN PRODUCTION OF FLOUR.

The largest flour mill in the world, located at Minneapolis, is equipped with 5,580 horsepower in electric motors. This mill has in one day turned out 16,125 barrels of flour.

A Pocket Telephone Silencer At Last

Although the telephone of today is in a very high state of perfection, several little things are still to be improved, one of which is a device which will make the speaker's talk unheard by those around him, but making his speech audible at the other end of the line. Thus the talker's conversation will be transmitted to the party who is listening to him, yet people sitting close by will not hear what he has to say. This is very important in large offices where several people use one telephone but where no private telephone booths are used.



Showing Size of New ~~Telephone~~ Muffler and How It Is Used So as to Silence All Spoken Sounds. Has No Mechanical or Other Connection with the Telephone Instrument Proper.

Various types of telephone *silencers* have been developed by different inventors and the patent office records show that about eighteen of them have actually been patented. Many of these succeeded admirably in confining the speech, but failed in that they made the voice inaudible to the listener at the receiving end. Furthermore, as a rule the telephone companies will not permit any device, whether it is good or bad, to be attached to any part of their instruments.

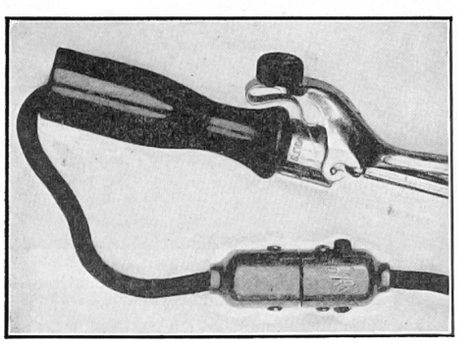
For several years Maximilian Weil, a prominent electrical engineer in New York, has been devoting his time to perfecting a *telephone silencer*. The first silencer which he brought out had the same faults as those developed by previous inventors, and was impracticable for commercial work. He again set out to perfect his device and has finally solved the baffling problem. He has succeeded in bringing out an excellent telephone silencer, which apparently has overcome all the defects of other proposed types. It is clearly shown here, and is called the "Privaphone." The principle upon which it works cannot yet be disclosed, due to obvious patent reasons. But a representative of THE ELECTRICAL EXPERIMENTER has convinced himself that the instrument does actually accomplish the inventor's claims. The small tube shown projecting from the bottom of the instrument is placed near the transmitter mouthpiece and it was found that with this tube the efficiency of the working qualities is considerably increased. This tube is of a certain shape and size. If a different size tube is used the efficiency is at once lost.

This silencer is quite small and can be carried in the pocket by anyone. For the office, however, Mr. Weil has developed an attachment to hold the silencer and receiver, thus leaving one hand free to write. The right hand view illustrates this arrangement. This photo shows the inventor using his silencer and the attachment.

The regular telephone receiver rests on a small box, or acoustic amplifier. The sound of the receiver is caught by this instrument, amplified, and sent through a rubber tube, which is connected to a special receiver. With this arrangement, the person using the new muffler has one hand free to write with. When the conversation is finished the regular telephone receiver is removed from the box and replaced on the hook. The two semi-circular rings on the amplifier cabinet are used to hold the silencer and attachment when not in use.

NEW NON-TWIST SWIVEL CONNECTOR.

A new form of swivel connector, intended to prevent the twisting and knotting of flexible cords, has recently been patented. This swivel is not separable as a connector. In general the operation devolves upon a central rod, which acts as one conductor, and one or two concentric ball bearing rings which form the other conductor. There are a number of special applications for this swivel. In the illustration it is equipped with a snap switch, and is used with an electric curling iron. Other special types are supplied for electric irons, attachment plugs and telephone cords. Since the cord contains three wires, two concentric rings and the center-rod are used as connectors. Manufacturers have already taken up this device for use with various electric attachments and apparatus. It has been approved by the fire underwriters and therefore will undoubtedly find a wide field of application.



An Ideal Swivel Connector Which Eliminates Twisted Cords and Short-Circuits. Ball Bearings Cause It to Turn Easily at All Times.

NEW TUNGSTEN DEPOSITS.

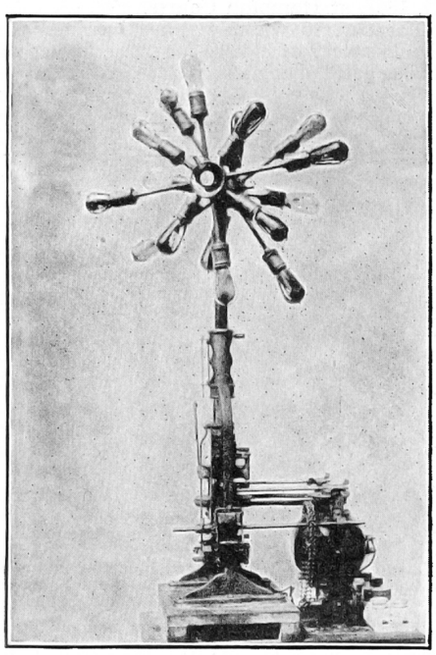
"It's an ill slide that slips nobody a piece of luck." News reports state that a Western mountain avalanche has uncovered tungsten deposits assaying eighty-five per cent., a mere matter of $8,000 a ton at present prices for the commodity.

Over 2,000 miles of the railroad lines of this country are now operated by electricity. In recent tests between steam and electric traction with the same load of freight up a 2 per cent. grade, the electric locomotive had an average speed of 15 miles per hour as against 7 miles for the steam engine.

ROTATING LIGHTS GREAT WINDOW ATTRACTION.

A very unique and interesting electric window attraction has recently been shown in the New York City stores. It consists of two wheels revolving in opposite directions and having several spokes of different sizes, upon which various colored electric lamps are mounted. These wheels are revolved by means of an electric motor, mounted on the base. The power is transmitted by means of a belt and shaft, projecting inside of another shaft, which causes both wheels to revolve simultaneously. The outside shaft also is revolved by the same motor and is connected at the proper time by a friction clutch actuated by a special cam which is caused to revolve by the same motor. The power is transmitted by a sprocket and chain as shown in photograph.

The operation of the device is extremely interesting and attractive. As soon as the lamps are lighted and the motor started the two light wheels begin to revolve very rapidly in opposite directions, which produces a rainbow effect. One of the cams then engages automatically the outer shaft which causes the wheels to revolve simultaneously, and at the same time they turn in opposite directions. The centrifugal force of both wheels causes some of the spokes to expand, which produces a wonderful intermeshing light effect. Although in reality the lights do not cross each other, yet when traveling in this way the eye cannot catch quickly the inter-lapping, resulting in a kind of optical illusion, which renders this effect so unusual. When this movement is over the inner shaft is disengaged by a cam and the two wheels are caused to revolve laterally without having each of the wheels turn in opposite directions. This also creates a curious effect. The last movement is perhaps the most interesting of all. By a special arrangement of the cams and clutches the wheels are caused to revolve in such a manner that one seems to turn half way and then come back again. Both wheels perform the same function but in opposite directions, and finally both assume a rapid whirling motion, caused by the interlocking of the outer shaft. The movements are then again repeated. This unusual yet simple machine has been developed and patents applied for by Charles Tregoning, a New York engineer.

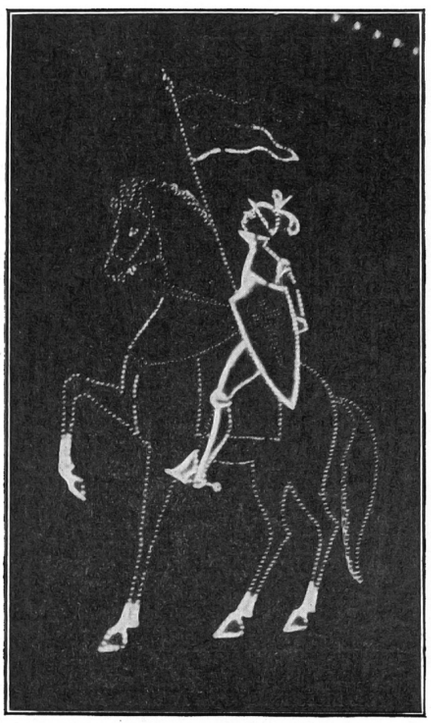


By Simply Rotating the Two Rings of Lighted Lamp Bulbs in Opposite Directions, Wonderful Effects Are Produced on This Apparatus.

THIS ELECTRIC "KNIGHT" A REAL GIANT.

By Charles Alma Byers.

The photograph reproduced here shows the huge electric-sign decoration which



An Electric "Knight" Standing 60 Feet High with His Charger. A Beautifully Illuminated Figure with Lamps of Various Colors.

graced the front of a department store in Los Angeles, Cal., during the Knight Templars convention held in that city in June. The sign represents a mounted *knight* and is about 60 feet in height, or equal to the height of five stories of the eight-story building, reaching from the top of the second story to the bottom of the eighth. The horse is shown in amber, the man in white, and the cross of the shield and a part of the banner in red. The picture shows the sign as it appeared at night, illuminated.

FEAR OF LIGHTNING.

During a severe thunderstorm at Newton, N.J., a woman who "through all her life of fifty years had felt a nervous dread of lightning" became unconscious from fright and died.

Cannot the multitudes of otherwise rational people who are obsessed by the same dread take counsel of the fate of this unfortunate and allay their fears? says the editor of the New York *World*. They actually suffer through a reign of terror in every thunderstorm and in effect undergo the agony of death many times. Yet there are few other forms of death so painless or so remote. In 1912 in the whole country only 243 persons were killed by lightning, of whom but thirty-two were females. Women who mainly feel this fear should be encouraged by their greater immunity.

But in fact a far greater number of people are burned to death in conflagrations in a year than are killed by thunderbolts, and the number of those who die from organic heart disease compared with those who die from lightning is as 354 to 1.

People who view their inescapable exit from this world with philosophy should be ready to accept a lightning stroke as an end as easy as any other. It is too instantaneous to admit of physical sensation; while the fear-ridden are assured that if the flash is seen the sufferer is safe for the time being.

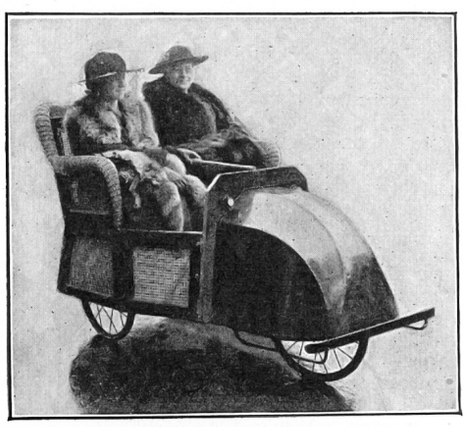
NEW STORAGE BATTERY ROLLING CHAIR.

The motor chair here portrayed consists of a motor, controller and storage battery mounted on substantial running gear with ball bearings and rubber tires. These are so skilfully correlated as to form a perfect running, self-propelled vehicle under absolute and easy control. It can be adjusted to any speed from one to ten miles per hour. When going down hill, the rated speed is not exceeded more than from ten to fifteen per cent.

It has one very important feature, secured by patents, which shuts off the current and sets the brakes when the chair comes in contact with any obstacle. This feature eliminates much of the danger of operation.

The control of the chair is very simple and practically fool-proof. There is only one foot pedal used, by which the starting, stopping and braking are all done. To start the chair, the rider pushes the pedal and the chair starts. To stop, he pushes the pedal forward until it locks and the chair is stopped with the brake set tight. The prevention of excess of speed down hill is effected automatically by an electrical method. It can be fitted with a hand control if desired.

The chair is guided and steered like an electric automobile with a steering handle requiring just the pressure or weight of



Now We May Glide Along the Board-Walk in Our Electric Rolling Chair.

the hand to guide it, and the tendency of the car is to run straight ahead on releasing the handle.

The chairs, fully equipped, weigh 400 pounds and will make the ordinary grades in parks and boulevards. The batteries are of the ordinary type and can be charged at any garage or at home.

These chairs combine all the advantages of ease in handling, cheapness in operation, exceptional safety and adequate speed. They provide means of pleasant and comfortable locomotion at seaside resorts, hotels, etc., and proved a big attraction at the 'Frisco exposition.

We strongly recommend all those interested in thunderstorm phenomena, the reason for lightning flashes, their nature and especially as to how to protect one's life, to read an extensive article entitled *"Lightning, Its Effects and How to Avoid Them,"* which appeared in the April, 1916, ELECTRICAL EXPERIMENTER.

"HELLO HAWAII, HOW ARE YOU?" LATEST IN RADIO MUSIC.

Oh, yes, it simply had to come! The song writers have now turned their energies toward the long distance radio telephone, with the result that "Captain Jinks one night on Broadway, all alone—read the news about the wireless telephone. Pretty soon his thoughts began to stray. Over seven thousand miles away," etc., so we learn. He sure was some old gad-about, was "Captain Jinks." What? Well, anyway he had a perfect right to let his mind wander Honoluluward and so have you, gentle reader, if your "roll" will stand the tune of about 500 cold simoleons per "talking minute."

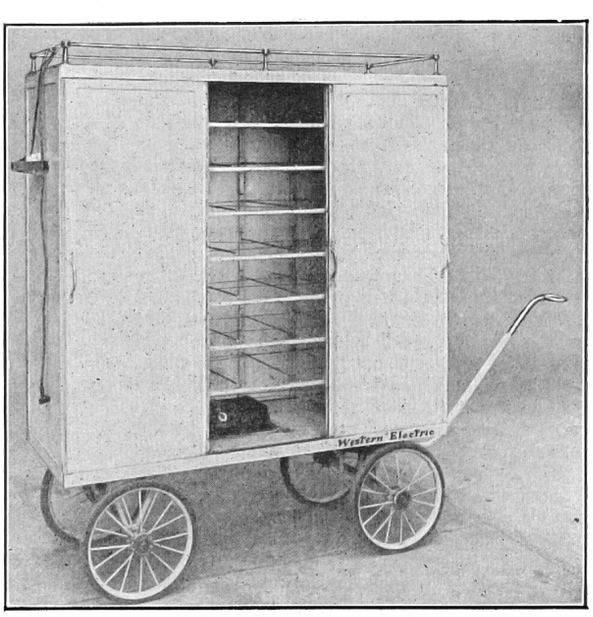
Aside from this the tune is catchy and is now heard up and down Broadway and in and out of the cabarets.

HOSPITAL FINDS NOVEL USE FOR THE ELECTRIC AIR HEATER.

The St. Mark's Hospital of Salt Lake City, Utah, has a set of four dumb waiters running from the basement to the first, second and third floors carrying food from the kitchen to the various wards. Great difficulty was encountered at first in keeping the food warm from the time it left the kitchen until it arrived at its destination.

Mr. Chadron, General Manager of the hospital, gave the problem careful study and finally designed and had built seven portable wagons. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air tight. A Navy Type air heater is mounted on the bottom of the wagon with a cord and plug attachment capable of being connected ten feet away from the wagon. An hour before each meal the heaters are connected to a source of electric current so that at meal time the interiors of the wagon are satisfactorily heated. After the wagons are loaded with the trays of food, the heaters are disconnected and the whole contrivance is placed on the elevator and raised to its destination where the heater is again connected to a source of current supply and remains so until the last tray is removed.

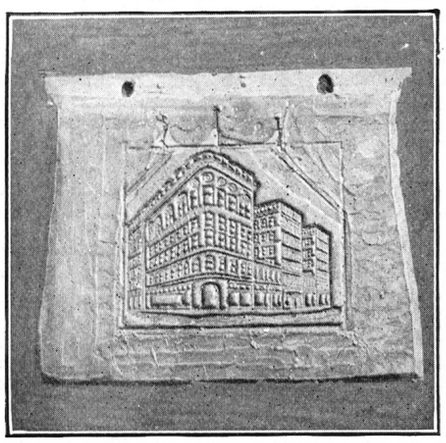
The new system is in constant operation and it is found to work perfectly—the food is served to the patients quite as warm and palatable as when it left the kitchen range. Photo courtesy *Western Electric Co.*



Novel Electric Heater on Wheels Used for Carrying Meals in a Hospital.

Electrotypes and Their Making

The general reader has possibly never stopped to realize the large amount of work that must be gone through to make an electrotype. This article has been prepared for the general layman, who has been mystified as to the process of making electrotypes, which is perhaps one of the most important features in the printing of a modern journal such as this one.



The Wax Impression Used as a Base in Making Electrotypes. Covered with Plumbago and Immersed in an Electroplating Bath, It Becomes an Easy Matter to Form a Copper Fac-simile.

The first step taken for making an electrotype from an ordinary photograph or line drawing is to re-photograph the picture through a finely engraved glass screen and then photograph it on copper or zinc; if a "half-tone" or engraving from a photograph is desired, copper is invariably employed. It should be understood that the metals are at first coated with some light sensitive emulsion, such as silver iodide. After the plate has been exposed, it is developed and fixed in the usual method; then it is coated with dragon's blood and baked in a furnace. After baking, the cut is placed in an etching bath containing concentrated nitric acid, which eats away all the copper which was not coated with the dragon's blood. Finally the plate is washed and fastened to a block which then completes the halftone cut. The electrical process is used whenever duplicates of these half-tones or line cuts are needed. These duplicates are termed *electrotypes.*

The entire page on which this article is printed, as well as all the other pages, are electrotypes. As it is not advisable to print directly from type and from the original engravings and line cuts—for they would wear out rapidly on a long printing job such as this journal calls for—the entire page is electrotyped. First the reading matter is set up on the linotype, then the illustrations are placed in their proper positions. A proof is pulled and sent to the editors. Corrections are then made and a "final" proof submitted in due course. After the Editor-in-Chief has o.k.'d this proof, the entire page is locked up in a printing "chase" and sent to the electrotyper, who makes one solid electro of the entire contents of the page. text as well as illustrations. Thus, instead of handling a lot of type metal and separate illustrations on the press, only one solid piece of metal—the electrotyped page—is used.

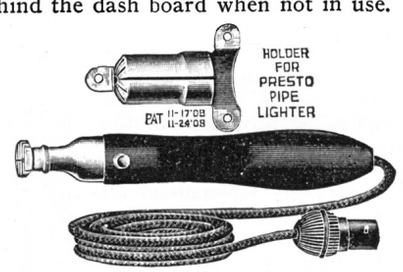
To make an electrotype the original half tone is forced into a beeswax compound by a special press. This compound consists of a mixture of zokorite, a by-product of the distillation of petroleum, mixed with one-third its weight of ordinary beeswax. To this mixture a certain quantity of powdered plumbago (graphite) is added to make the compound more slippery, as it is technically called. It is used for making the wax more adhesive so that when the original cut is removed, no portion of the wax will stick, as it would tend to show in the finished electrotype. The wax impression is then removed and treated with a fine powder of plumbago. This is lightly sprinkled over the wax surface to make the wax a conductor of electricity. The mould is now trimmed around its edges with a curve-shaped knife in order to remove all parts that are not wanted in the finished electro. The wax cast is next placed in a machine brush which polishes up the surface of the wax with finely powdered plumbago. Then after receiving the proper finish, it is thoroughly rinsed with water and coated with a fine layer of iron filings, making it a still better conductor to the electric current. The iron-coated form is now washed with a copper sulphate solution (blue vitriol), which precipitates a thin film of copper over the entire waxed surface. This is the last process of making the wax conductive. Finally it is placed in a copper plating bath and connected to the cathode, or negative terminal of the electric dynamo, while the anode, or positive electrode, consists of a pure copper plate, which is linked to the positive side of the electric generating machine.

The solution of the plating bath consists of copper sulphate crystals, dissolved in water. In this way the mould receives an even coat of metallic copper, due to the transmission of copper from the plate to the surface of the metalized-wax mould by the current.

After a firm coating of copper has been deposited upon the cast, the electric current is shut off, the mould removed and then thoroughly washed with clean water. The fine film of copper representing the impression of the original half-tone or line cut of the mould is now carefully removed from the wax. The raised portion of the copper film is used for printing while the impressed portion is filled with molten type-metal to strengthen the completed electrotype. When the molten metal has cooled, the electrotype is trimmed with a metal saw and nailed on a wooden block of standard thickness. The surface of the cut is then carefully gone over by an engraver to strengthen the important lines. This is the last step taken in the making of an electrotype. It is then ready for the printer.

NOVEL ELECTRIC PIPE AND CIGAR LIGHTER.

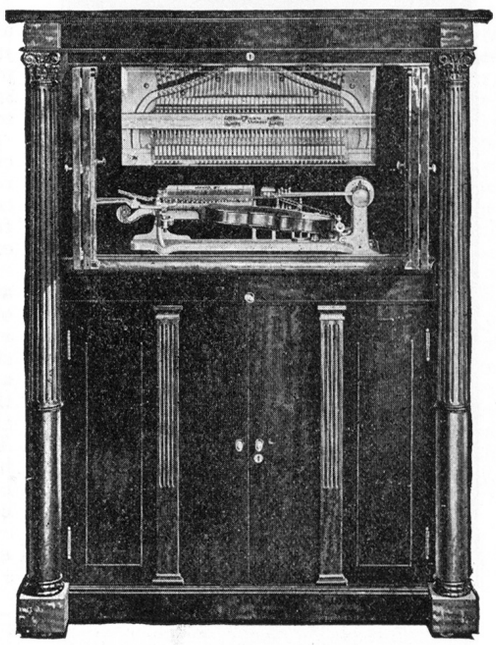
A new electric cigar and pipe lighter, designed especially for automobile use, is now being manufactured. The ten foot connecting cord is wound up by a spool, so that it can be kept under the seat or behind the dash board when not in use. A spring tension actuates the spool. When the switch is closed a grid at the end of the handle becomes incandescent. Since this is not affected by the wind, a pipe or cigar can always be lighted from it.



Electric Cigar Lighter with Holder.

AN ELECTRIC VIOLIN AND PIANO.

Most people realize that the violin is perhaps the sweetest musical instrument in existence, if a skilled player uses it, but today very few violinists exist who can handle the instrument with sufficient technique to produce the supremely sweet tones of which the instrument is capable. Of late, scientists and musicians have labored on an automatic musical instrument which would reproduce the tunes just as well as the best player and the result of their efforts is illustrated in the photograph.



Both Violin and Piano Music Are Produced by This Electrically Operated Device.

The violin rests horizontally in the upper corner of the cabinet, while back of the violin are the various wires of the piano. The fingering is done by means of sixty-four individually controlled electro-magnets, which actuate the fingers. The bowing is done in a similar manner —the different strings having separate bows which consist of circular disks of special grade leather. These are automatically controlled both in speed and pressure by electro-magnets. The proper amount of rosin for the strings is also automatically applied.

The strings and bows are manipulated by a perforated roll, each perforation corresponding to a certain distinct note. When the instrument is in operation the roll is drawn smoothly between rows of metallic points or brushes. At the very instant when the points of one brush touch those of the other through these perforations, an electric current is sent through the particular electro-magnet which actuates the finger and bow. The perforations on one side of the roll control the playing of the violin; those on the opposite side control the playing of the piano.

This piano control is somewhat like that of a compressed-air player piano in which a perforated roll is drawn across a metal bar, containing apertures through which air is drawn. The ordinary player piano is operated by the pumping of bellows and is governed by the hand movement of levers, but in this new type, the piano-string hammers are actuated by electro-magnets controlled by the perforations of the paper roll.

This is another achievement in automatic electric musical instruments for those who cannot play themselves.

The Unterrified Amateur

By Thomas Reed

AN amateur wrote to the Question Box last fall some time: "Please tell me how to make an Audion bulb." Simply and casually, like that—just as Mrs. Smithers would run over and ask your mother for her receipt for raised doughnuts.

He was a regular fellow, that "bug," and I liked him. An Audion bulb! You bet there was no such fool word as "impossible" in his bright lexicon.

Now the Question Box editor is a humane man and wouldn't hurt an amateur if he could possibly help it; they say he wouldn't even run over one with his Ford car (provided he owned one), he is *so* particular. But when he saw that question he recognized that it was up to him to be "cruel only to be kind." Reflecting upon the variety of malicious tricks that glass can play, he sought to shield the rash "bug" from an attack of bitter disappointment. So he swallowed a mugful of liquid concrete, to harden his heart, and phoned the printer to set up in cold type the fatal answer: "Unless you have the equipment and skill for glass-blowing, it can't be done."

Well, do you think that "bug" gave up his project? Not a bit of it. I don't know him from Adam, but I know he didn't. No mere Question Box answer would convince him that he couldn't make an Audion. He just thought the editor was mean, or lazy, or something, and wouldn't tell him; so, without any further worry, he dug into the encyclopedia, read up on glass-blowing, and went at his Audion, editor or no editor.

He couldn't make the thing, I'll lay dollars to doughnuts on that; but he knows a lot about glass now that he didn't before. No knowledge, once acquired, is useless. If he ever gets so he can make glassware, he can turn that knowledge into a real nice simile for certain women; he can say they are like glass, because they are innocent and self-effacing, apparently, but full of the most diabolical obstinacy the minute you try to do anything with them. (Cheese-it, madam, drop that stove-lifter; I only said "certain" women, didn't I? I didn't mean you at all.)

The reason I know so much about this amateur is because, years ago, I tackled a similar impossibility, an X-ray bulb. From an unbroken series of victories in science, our crowd had come to consider that they had the world pretty well by the tail. (The really hard things of life, such as selling a bill of goods, were as yet mercifully hidden from us.)

About that time Mr. Röntgen showed up with his X-ray apparatus, and the population went daffy over the ability to see the inside of a foot, or a pocket-book, or any old thing they had no business to see inside of.

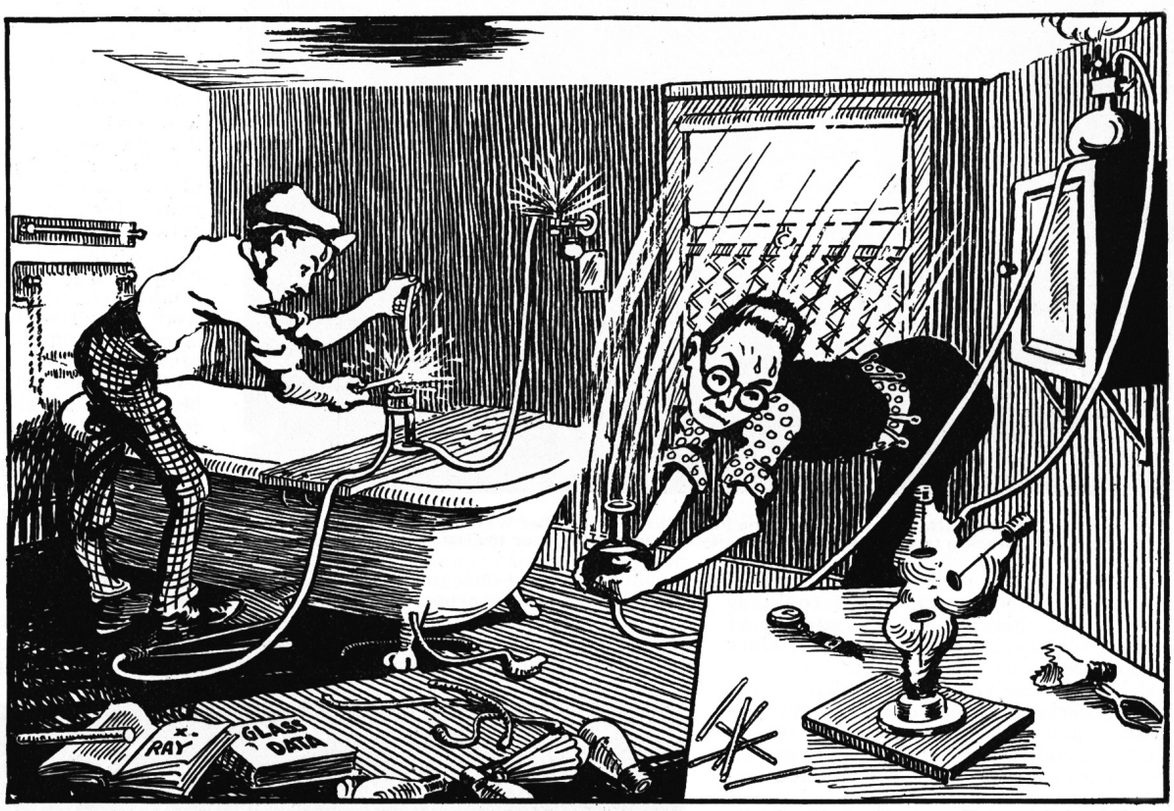
I remember the first thing mother thought of was that Mrs. Skillings, next door, might get one of the things, and train it on our house, and see how awfully untidy the attic looked. To be on the safe side, mother went and cleaned up the attic, though it was right in the middle of the hot weather. When she got through, she was tired, and sort of mad, and said she wished people would stop inventing things.

Our crowd decided very soon to make a Crookes tube, and test out this X-ray thing. Of course we were not prompted by any petty curiosity, such as mother charged on Mrs. Skillings. Men have no curiosity; what they have is *scientific interest*. Science, however, may make use of human frailties to further worthy causes; so I approached mother for a small investment in the enterprise on the prospect that she might look into Mrs. Skillings's attic. But mother said she didn't need to; anybody who kept her front steps looking the way Mrs. Skillings did had a dirty attic as a matter of course. So we had to finance the proposition ourselves, as usual.

As I remember it, our combined stock of knowledge regarding the art of glass-blowing consisted of the fact that it required heat. We bought a length of glass tubing and engaged in a series of preliminary experiments over the fishtail burner in the bathroom. By the time the first length was used up we knew quite a few additional things about glass; for instance, that it cracked readily; that bending a tube had quite a tendency to close up the hole—it was not elastic, like macaroni, but on the contrary flabby, like a promise to pay back two dollars. Bulbs blown out on it were inclined to be warty and small, rather than symmetrical and large, and if urged too far, they punctured with a noise that sounded like "Flap!" And first, last, and especially, we learned that the physical effect of prolonged blowing was an interesting symptom resembling the more finished stages of acute apoplexy.

These facts, useful as they were, did not advance us far toward the X-ray. Instead, they led us back a step; for we had to build a blowpipe, which we could use in our accustomed haunt. We were also influenced by a certain restiveness which had developed in the family, due to our continuous occupation of the bathroom.

The blowpipe worked beautifully. It had a nice foot-bellows and produced an invisible flame that our fingers had a perverse way of getting into. We bought another yard of tubing and began to blow shapes. They were interesting shapes, some of them; but, as they seemed to be the result more of accident than design, the doctrine of probabilities was dead against our happening to hit one that would do for a Crookes tube—that is, within a reasonable time, like a century.



"We hitched on our poor, mis-shapen Crooke's bulb and began pouring that mercury. You put it in at the top, I recall, and it gurgled down through the thing till it came out at the bottom and you caught it and started it all over again. Its gurgling was supposed to gurgle the air out, but somehow it didn't."

We recognized this; and, looking about us, as amateurs do, for articles in the domestic world that can be adapted to the purposes of science, we discovered a plentiful supply of just-what-we-wanted in electric-light bulbs. Owing to unavoidable casualties, we required a good many. We used up all the burned-out ones in the box and then levied cautiously on the active sockets. It was a close call; but just as we were about to encroach on the lamps the family would miss the quickest, we achieved a success, producing a bulb with all three tubes stuck on, good and tight, though somewhat blobbily.

The cheering over this accomplishment had hardly died away, however, when someone noticed that we had forgotten to put in the cathode. You know how it feels when your trunk is all strapped and the expressman is stomping up the front stairs after it, to find your best suit left out on the bureau? It is something like that, when you find a half-inch disc lying around that

(Continued on page 372)

The Electrical Mechanism of the Ether

By A. Press, B.Sc.

THE electrical theory of Maxwell was based on the assumption that when a body was electrified something in the nature of a displacement passed from the body into the ether, and from the ether to some other material object or objects said to be thereby oppositely electrified.

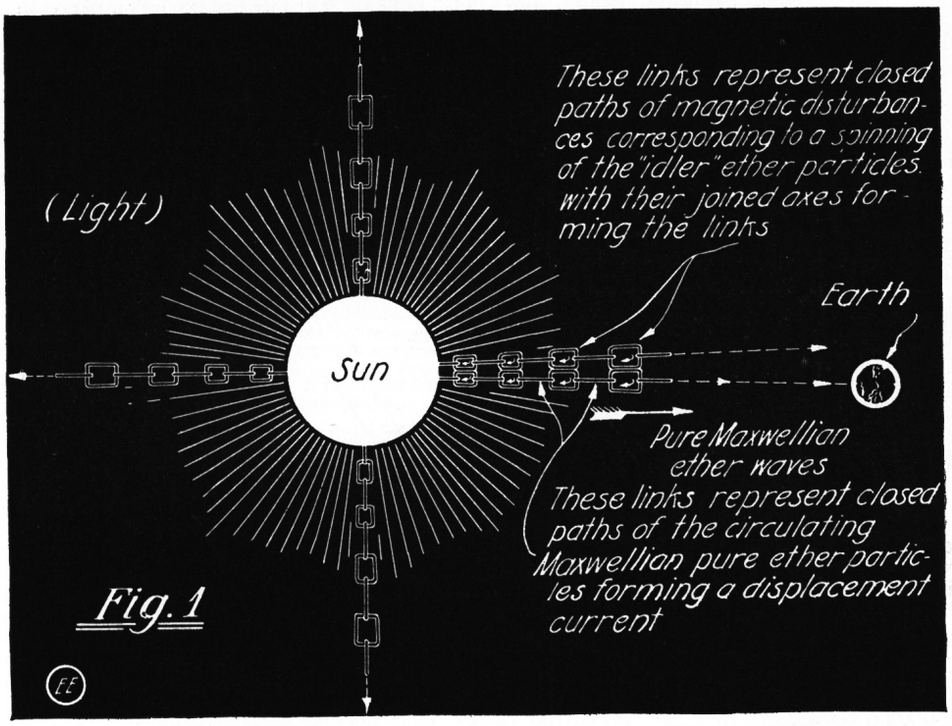
That the displacement was not material, that is, it had no weight, went without saying, for with the most delicate chemical balance no difference in weight could be detected. It, therefore, had to partake of an ether-like displacement because the ether is supposed to have no weight.

Maxwell conceived the idea that it was this mysterious displacement, by an unrevealed physicial mechanism, that caused electrified bodies to be attracted or repelled according to the well-known material Newtonian laws of mechanics.

Whereas, the electrical displacement itself is intangible as it were, because it involves the ether only, forces always very visibly manifested at the material bounding surfaces of the ether were conceived to take place by virtue of a special displacement mechanism which Maxwell assumed. This displacement mechanism was considered to be located in the ether itself rather than in the electrified material bodies.

Forces there must be in the ether, but it is necessary to remember that we can make sure of their existence only by mechanical reactions of the ether upon material bodies. When the forces wholly refer to the ether they are designated as "generalized" forces. Thus, although an electro-motive force is regarded as setting up a flux of electric displacement this *force* cannot be considered a true force in the Newtonian sense, for matter is not involved, except indirectly. The mechanical or Newtonian forces that are observable on electrified bodies always imply matter. Electrical instruments are employed it is true *to measure* E. M. F.'s (potentials) and currents, but it is very obvious that what we are really measuring are the reactions of the ether upon material bodies and not the *forces* that act wholly and entirely on the parts of the ether medium itself.

The question can arise whether electricity as such can exist apart from matter. Heaviside is decidedly of the opinion that it cannot. We know that like charges repel each other and therefore the functions of material bounding surfaces for the ether appears to be to keep the like elemental charges together. Just how this property is maintained is at once one of the mysteries and distinguishable properties of matter.

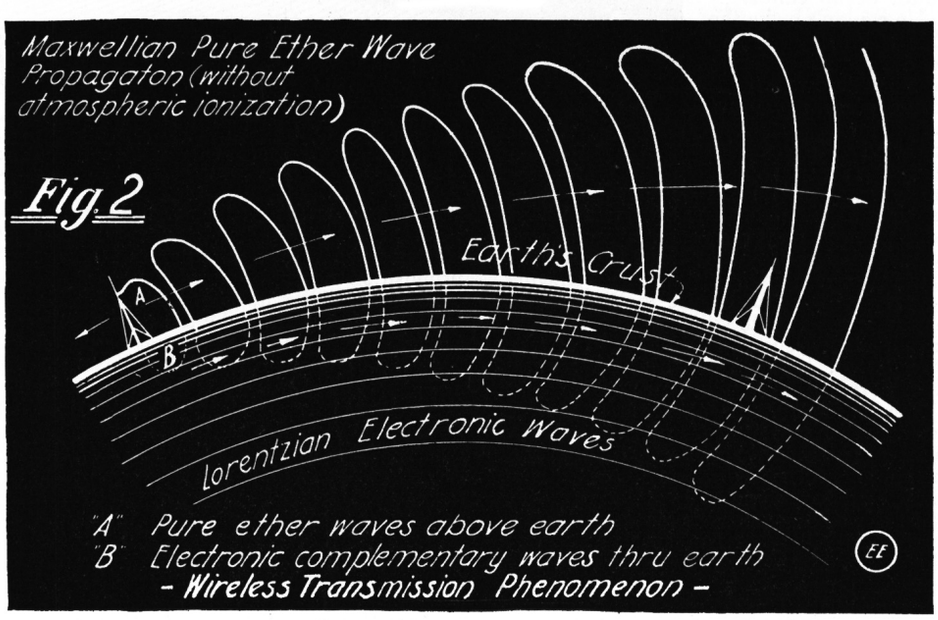


A Schematic Representation Showing How the Pure Maxwellian Ether Waves Pass Thru Interstellar Space from the Sun to the Earth with Velocity of Radiant Light or 186,000 Miles per Second.

In the newer theory of Lorentz, electrification or displacement is said to be due to *electrons.* In the first place it is difficult to see how any portion of electricity can manifest itself except by a material reaction which can account for a Newtonian force being set up, yet single negative electrons have been observed. Again, if the electron or *atom of electricity* were of the imponderable ether substance then there is difficulty in accounting for the elemental electric charge keeping itself intact; for even an electron is supposed to have dimensions. It was from this latter sort of consideration that Heaviside foretold that the observable electron would be found to have a *material nucleus.* It would also seem to nullify the earlier electric particle hypothesis of Maxwell.

Strange to say in attempting to form a physical picture of electrical displacement, Maxwell himself imagined a sort of purely ether particle which bears a very close resemblance to Lorentz's electron particle. However, such makeshift devices, for such they are, do not by any means enable us to explain how mechanical energy can be converted into electrical energy or how electrical energy, such as the electro-magnetic light waves from the sun, can be transmitted through space to be thereafter transformed into work in the service of man, or how even to interpret matter in terms of the ether.

Both Lorentz and Maxwell imagined their ultimate electrical particles to be of such a nature that, in what are called dielectrics or insulators, the electrons are only capable of moving a very short distance from their normal state of equilibrium; whereas in conductors, such as copper, the electrons were considered to be free and capable of being set in motion by appropriate etherial or as we would now express it—electro-motive forces. Such *forces,* as has already been indicated above, are not to be confounded with the mechanical forces such as pressure or inertia. Yet when a conductor passes through a state of the ether called a magnetic field, the electrons in the conductor are assumed to be impelled in a certain direction. So far as the electrons are concerned, it is an electro-motive force that causes the electrons to travel through what are really the large-sized pores of the metal; but so far as the copper or material conductor is concerned it is a Newtonian mechanical force or pull that will be found necessary to be applied to set up the electronic displacement.

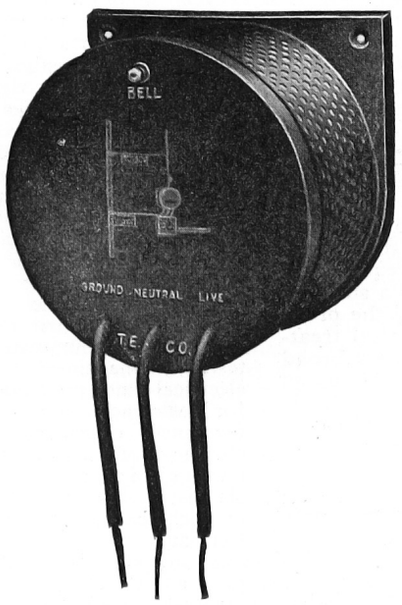


The Complex Action Occurring When a Wireless Wave Speeds "Over" the Earth and "Thru" It, by Virtue of Pure Ether Waves (Above) and Electronic Propagation Below the Earth's Surface.

(*Continued on page 374*)

RESISTOR TYPE D.C. BELL RINGER.

This bell-ringer differs from the usual type in that it reduces direct current by resistance. The low-pressure current varies from 6 to 35 volts. In one type there is a constant current consumption of 0.6 ampere. Another type, however, consumes



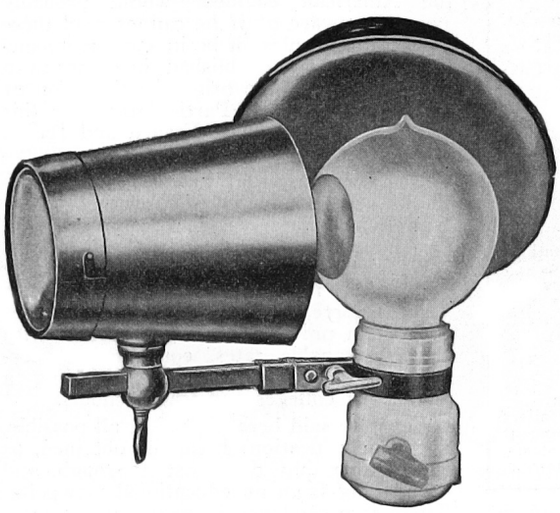
Bell Ringer for Direct-Current Circuits Working on the Resistance Principle.

only 30 milli-amperes ordinarily, but when the bell circuit is closed a relay connects a low resistance coil on the primary side. The current flowing is then 1.5 amperes. Different sizes of these instruments consume from 5 to 200 watts, for running interior telephones, electric clocks, time stamps, thermostats, ignition coils, cauterizers, miniature lamps and toys. It fulfils the function on D.C. circuits of the transformer used on A.C. circuits.

NEW INCANDESCENT LAMP CONDENSER.

An improved incandescent lamp concentrating lens is shown in the accompanying illustration. This condenser is a great advantage to dentists and other artisans requiring a concentrated form of light.

It projects an intense white light in an approximately parallel beam, without shadows or reflections of the filament within



A Powerful Condenser for Use with Incandescent Lamp and Capable of Projecting an Intense Parallel Beam of Light.

focal distance. The clamping device supplied with the condenser permits it to be attached to any standard lamp socket.

AN ELECTRIC HOT-AIR TOWEL.

A very unique hot-air towel nicknamed "The Notowl" has been recently brought out. By pressing down a foot lever located at the base, air is drawn into an air shaft by a suction fan and is passed through a heating element, comprised of coils of high resistance, connected to the current mains. The heated air is then forced out through a small pipe opening at the front of the machine.

This sanitary appliance takes about twenty to thirty seconds to dry the hands, a process to be accompanied by vigorous rubbing. The sanitary advantage of this device over the towel is apparent to all familiar with big building equipments. Moreover, it is so constructed that no amount of investigation on the part of public meddlers can put it out of operation.

Another advantage of the hot air towel is that its cost for upkeep compared to towels is only one-fourth as much. Of course this figure is obtained from an office which is employing a large number of towels.

The lens can be easily cleaned and replaced by removing the caps on the condenser barrel. To exclude light the separate shield may be attached to any part of the rim. The condenser lens barrel may be moved along the horizontal bar secured to the socket as perceived, and then clamped in the desired position.

REPORT OF APRIL MEETING OF THE INVENTORS' LEAGUE OF THE U. S.

President Whigelt called the meeting to order. The minutes of previous meeting were read and approved. Mr. G. W. Speirs, in the absence of Mr. Lackner (excused), acted as secretary pro-tem.

Communications were read and placed on file as follows, viz.: From Mr. H. D. Sears, our League's attorney, who is at present in the southwest. From the chairman of the patent law committee of the House of Representatives, regarding some amendments against which the League protested. From Mr. Charles P. Steinmetz accepting his election as Honorary Member.

The resignation of Mr. Charles C. Gladwin was unanimously accepted.

At the request of Mr. Haggerty, Mr. Fowler explained the relationship between employer and employee, in regard to "Who should be entitled to full ownership of an invention or original idea produced during the time of employment." This created considerable interest.

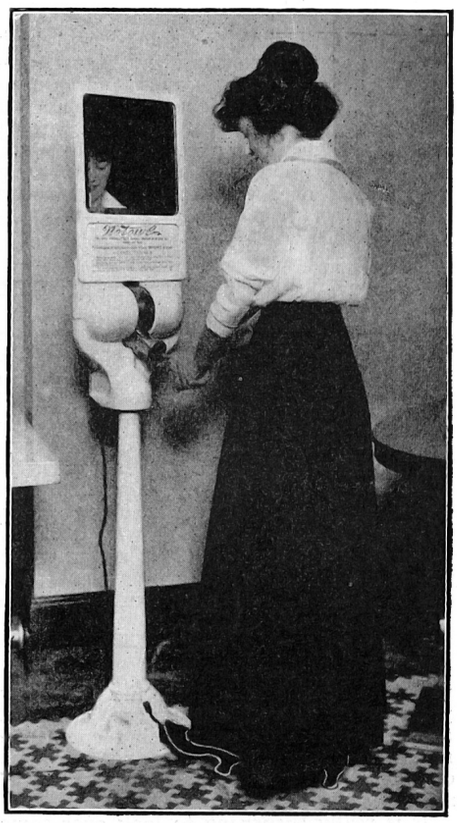
President Whigelt explained a few items in connection with the suggestions made by the attorney-members regarding the enactment of new patent law amendments, several of which were of considerable viciousness and against the interest of investors.

Mr. Waring demonstrated the many advantageous uses and features of his newly improved baseball mit.

Mr. Haggerty placed in nomination as honorary member, Mr. Henry Ford, who was unanimously elected as such. Mr. Ford's interest in the League was shown by the previous visit of his personal representative.

The upholding of our high standard of membership was discussed by a number of those present and an increase in membership is anticipated. Mr. Kampel was appointed by the President as a member of the House Committee in place of Mr. Charles C. Gladwin, resigned.

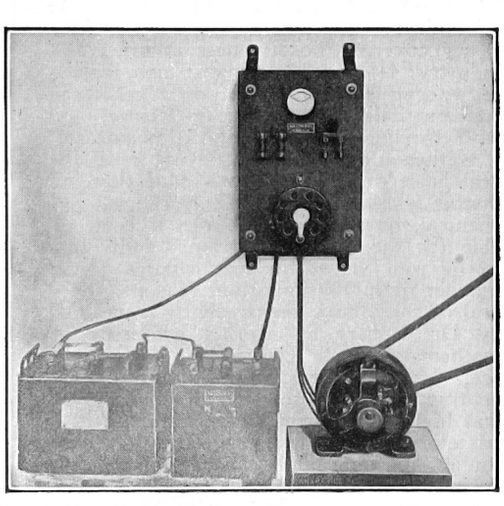
The mirror in front of the machine should greatly appeal to all female users.



The "Notowl" Comprises an Electrically Driven Heater and Blower Controlled at the Touch of the Foot.

NEW BATTERY CHARGING EQUIPMENT.

A number of charging panels have been brought out during the past few years. Each type seems to outdo the last, either in efficiency, simplicity or low price. The set illustrated here is one of the most economical for a garage equipped with motive power. The dynamo generates sufficient current to charge one to five six-volt batteries up to two, twelve-volt cells. Any voltage, from 2 to 30, can be used. The outfit is supplied complete with a switchboard mounting a two-way ammeter, rheostat, main line switch and fuses, two connecting leads, 40 volt generator,



A New Simplified Storage Battery Charging Outfit for Autoists.

blue-prints and instructions. These sets are widely employed now that electric lights are used on autos.

Engineering As a Vocation. An Article for Students and Parents

By H. Winfield Secor, Assoc. A. I. E. E.

NOW that the college and high school sessions will soon begin their activities anew and as hundreds and even thousands of young men will, in the nature of things, be obliged to select their life work, it behooves every one, whether choosing for himself or for his children, to spend a more than passing thought on the subject.

This article will deal particularly with some of the advantages and requirements necessary in the engineering profession, particularly the electrical branch.

In the past few years there has been a great impetus given to engineering in general, and to-day we have with us a greatly diversified ramification of engineering branches, and sub-divisions. No longer can we speak of this term in a general sense so as to infer any definite scope of activity, as this line of human endeavor has become very highly specialized in the last few years. There are, for instance, electrical and mechanical engineers, civil engineers, mining engineers, telegraph and telephone engineers, radio engineers, chemical engineers etc., *ad infinitum.*

It is really surprising to look over some of the catalogues and literature put out by our engineering schools of all classes, including correspondence institutions, to note the many new branches of applied science which have become sufficiently important to warrant the offering of a course of study in that line only. To begin with, not every man (or woman for that matter, as we do really have some female engineers and architects with us now) is adapted physically and mentally for the vocation of engineering, speaking generally. In a preliminary investigation recently made by the Carnegie Foundation for the Advancement of Teaching in New York City, there were found to be six desirable groups of factors which are essential to the successful engineer, as follows:

1—Character, covering integrity, responsibility, resourcefulness and initiative; 2—Judgment, covering common sense, scientific attitude and perspective; 3—Efficiency, covering thoroughness, accuracy and industry; 4—Understanding of men, including executive ability; 5—Knowledge of the fundamentals of engineering science, and 6—Technique of practice and of business.

Mathematics is, in most every case, the real basis of the engineer's education, no matter whether it be civil, electrical, mechanical, or radio. Moreover, it is desirable for the technically trained individual to be well versed in mathematics for a number of highly important reasons. Several of these have been recently mentioned by Dr. Robert E. Moritz, professor of mathematics at the University of Washington. He states, among other things, that, contrary to the obsolete and popular idea that higher mathematics are nothing but a waste of time for the average student; these studies, and only these, can develop the following powers of the human mind:

1st. The power of undivided attention and prolonged concentration. 2d. The power of exact definition, of clear statement and of a critical and concise analysis. 3d. Power of deductive reasoning, of drawing logical conclusions from given premises.

One of the first things which should be done by prospective engineering students and parents intending to send their children to colleges or other academical institutions, is to obtain catalogues from the leading schools teaching various technical subjects. A number of worthy technical schools advertise in this journal and information concerning colleges and schools featuring engineering subjects will be given if those interested will address the author in care of this magazine, enclosing stamped envelope for reply. From this literature a great deal of information can be obtained, and whenever possible it is preferable to have a conference with an engineer who has been in the business for a number of years and who can explain the many practical as well as business features of the profession, topics which are either ignored altogether in the average college prospectus or else much overdrawn as in some of the brochures put out by some of the second rate schools. The fact of the matter is, that between these two there is a happy medium which the student must decide.

ARE you contemplating taking up a course in engineering? If not you may possibly be otherwise responsible as the guardian of a young man who thinks he will like engineering as a life work. Read this article before deciding on a vocation which, among other things, requires an aptitude and affinity for abstract philosophical thought. To be a successful engineer one should have a real liking for mathematics and the problems occurring in everyday work which require an exact analytical treatment for their solution. Engineering to-day has indeed become a broad subject, embracing not only technical studies but business problems as well in many, if not a majority of instances. The business man who is first an engineer is the more likely to succeed in a great number of cases, particularly where intricate scientific details are involved in the manufacture of his goods.

The outline of studies for a general electrical engineering course given below will provide a nucleus upon which to build a good idea of the knowledge required of the graduate on this subject. About three years' continuous or four years' (with summer vacations) time is necessary to complete such a course usually.

- Arithmetic
- Elements of Algebra
- Logarithms
- Geometry and Trigonometry
- Graphs Calculus.
- Geometrical Drawing
- Mechanical Drawing
- Sketching
- Practical Projection
- Development of Surfaces
- Principles of Mechanics
- Machine Elements
- Mechanics of Fluids
- Strength of Materials
- Heat and Steam
- The Steam Engine
- The Indicator
- Engine Testing
- Governors
- Valve Gears
- Steam Turbines
- Electricity and Magnetism
- Electrodynamics
- Electrical Resistance and Capacity
- The Magnetic Circuit
- Electromagnetic Induction
- Chemistry and Electrochemistry
- Primary Batteries
- Electrical Measurements
- Dynamos and Dynamo Design
- Single-Phase Railway System
- Alternating Currents
- Alternators
- Alternating-Current Apparatus
- Design of Alternating-Current Apparatus
- Electric Transmission
- Line Construction
- Switchboards and Switchboard Appliances
- Power Transformation and Measurement
- Efficiency Tests
- Mercury-Vapor Converters
- Storage Batteries
- Incandescent Lighting
- Arc Lighting
- Voltage Regulation
- Modern Electric-Lighting Devices
- Electric Signs
- Electric Heating
- Interior Wiring
- Electric-Power Stations
- Telegraph Systems
- Telephone Systems
- Radio Telegraphy
- Radio Telephony
- Applied Electricity
- Electric-Railway Systems
- Line and Track
- Line Calculations
- Motors and Controllers
- Electric-Car Equipment
- Multiple-Unit Systems
- Direct-Current Motors

It goes without saying that unless one is of a studious disposition, and particularly along the lines of philosophy and mathematics, it is very doubtful whether they should seriously undertake an engineering course, with the object of a life vocation as the goal. The course of study in any first-class school or university is rigid, as it should be, yet comprises a sufficiently broad outline of topics to give a well-rounded education. The electrical engineering subjects include mathematics, mechanical drawing, physics, steam engines, various types of dynamos and their design, alternating and direct current systems, electric railway work, illumination, testing of machinery, both electrical and mechanical for efficiency and performance characteristics, electric motors and their industrial application, chemistry, besides studies in technical French and German.

The curriculum of some schools includes, among other studies, additional languages such as Italian or Spanish. A knowledge of these languages is of paramount importance, and is one, perhaps, which every engineering student, at the start, will certainly balk at. He will not be able to see just why he should be required to study these "dead" subjects, as he feels sure he will never have to go abroad to install an electric generating plant or telephone exchange. This has really nothing to do with the reason as to why these languages should not be mastered, at least in their technical phase. The unequivocal necessity for these studies lies in the fact that some of the best literature available on all branches of technology and engineering, exist in foreign books and periodicals.

It is true that there now exists a goodly number of excellent books in the English language on all ordinary technical subjects. However, there are a number of valuable periodicals published in various old world countries, which, from time to time, contain extremely important articles by leading authorities and scientists. These the American engineer would probably never be aware of if he cannot read these publications, unless it be in some poignantly brief excerpt published in America a year or so after the original publication of the foreign paper. Particularly does this hold true for German, French and Italian periodicals.

Not every aspirant to engineering laurels has the means or wherewithal to attend a first-class college or university in the pursuance of his studies. There are several other classes of schools which may help him, including the correspondence school; correspondence extension branches of certain universities; night schools with their reasonable rates, conducted at certain educational institutions including a number of colleges and trade schools.

Let it be said here, that if at all possible, a college education should be obtained, as it is invariably the most thorough and broadening from an educational viewpoint. There is a tendency in many of the middle grade school courses to confine students to the technical subjects only, and in this way his education in general is apt to suffer, with respect for example to studies in history, grammar, and the various languages, which are required in the course of

study at every first-class academical institution of standing. On the other hand, with a little forethought and guidance from those who are in a position to know, it is possible for the self-educated man to broaden out in his sphere of activities, and to even surpass in education, the college bred engineer. Like most other avenues of human endeavor it depends to a very large extent upon the individual himself. He must, in any event, learn to look up data bearing on certain problems and how to interpret the matter he finds.

There are many state colleges and others throughout the country who make a special effort to reach the student with but slight financial means, and a considerable number of them have a special staff to look after the welfare of new students, especially those who are desirous of working their way through college. With a little help of this kind many a worthy aspirant can obtain a remunerative position covering a few hours each day which will sufficiently reimburse him so that he can follow his studies, and support himself.

The general electrical engineer of to-day is a rare species indeed. Generally speaking, from personal observation extending over a number of years, there are actually but few electrical engineers in the broad sense of the word. The majority of the profession have specialized in certain particular lines. Thus in the telephone field alone, there are thousands of engineers and specialists who have found a fruitful field for all their energies and proclivities. This applies likewise to the telegraph engineering field, as also radio telegraphy, electrical railway work, electric signaling, storage battery research and industrial application, dynamo and transformer design, electrochemistry, hydro-electric development, etc., etc.,

For the information of the uninitiated, it may be said that a great many of the graduates of our engineering colleges and universities find employment with large electrical and manufacturing concerns, while some of them eventually branch out into the consulting engineering business, electrical contracting and its various phases and possibilities.

First, last and always, the engineer, of no matter what *ilk* or *ology,* is forever a student. In ten short years—nay, even in five years, a very marked and appreciable change will have taken place in many branches of engineering, especially electrical engineering, and more particularly in radio work. That is to say then, that the student who graduated five years ago would indeed find himself far behind the times, if he had not studied closely the latest books and periodicals on his chosen subjects as they appeared from month to month and from year to year.

The amount of new literature published in the past few years on electrical and radio engineering, particularly the former, has well nigh promised to completely flatten the pocket-book of any ordinary engineer. The libraries of our large cities provide excellent reading facilities however. Thus it is possible for practically everyone to satisfy his desires in the thirst for more knowledge.

After the engineer or student has gone through his four years or more of difficult studies in algebra, trigonometry, physics and electro-dynamics, *ad lib.,* and even though he has been so fortunate as to provide a respectable private library of the more desirable and important works, covering his line of work, he will find it sooner or later very advantageous to become a member of one or more of the various Engineering and Technical Societies which maintain branches in the larger cities. One does not have to be a resident member of any of these cities to receive beneficial results from such a membership, as practically all of them publish their papers in the proceedings which are mailed to all of the members quarterly, and in some cases monthly, the latter being the case with the American Institute of Electrical Engineers. There have been a number of important papers presented before the Institute of Radio Engineers on wireless subjects in the past year or two, and which certainly never would have reached a great many vitally interested in this line of science, if they had not been on the roster of this organization so as to receive by mail the *Proceedings* containing the different papers.

Of course there is no glory for most of us in graduating as an engineer from any school, and the whole subject boils down to the matter of cold dollars and cents. This is an important subject, and one which should receive early attention from those now actively engaged in the profession. Certain it is that most other professions whether legal, medical, or what not, manage in one way or another to gain worth while emoluments and remunerations for services rendered. The engineer, however, speaking generally, and after his four arduous years of study is expected to work for several years while he is "green," as

(*Continued on page 374*)

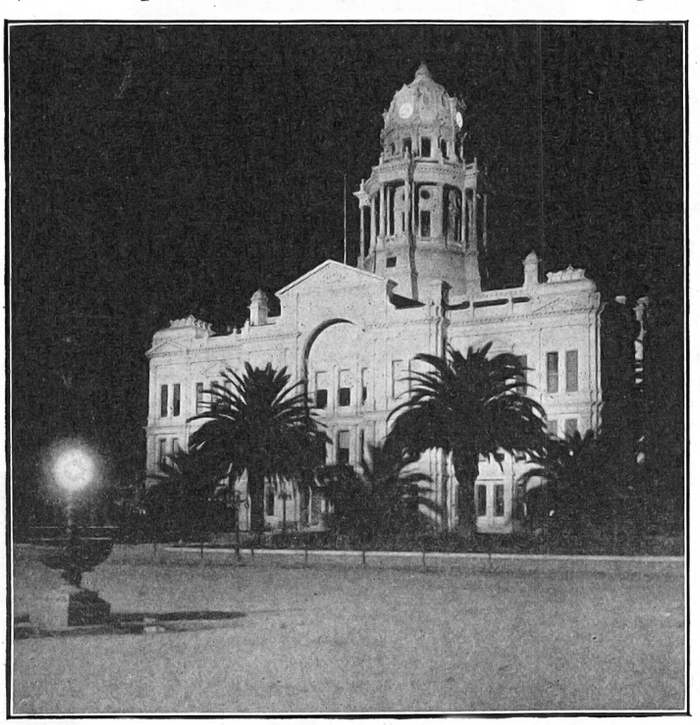
COLORED ELECTRIC ILLUMINATION.

During the San Francisco Exposition wonderful electrical illumination effects were used. The photograph here illustrates one of the court-houses at Stockton, California, illuminated with colored electric lamps, instead of the ordinary white ones.

The lighting installation consists of four 500-watt flood lighting units, located on the roof of a three-story building, directly across the street. As this building is the center of a beautiful square, it is planned to light all four sides with twenty projectors in banks of five units each, each bank to be located on the roof of the building opposite each corner of the square.

Unfortunately, the beautiful colored effects of the court-house are not brought out by photographs. Red is used to light the columns at the base of the domes and back of the railings at the center of the domes. The lamps were hidden by reflectors mounted back of the columns and railing. The flood of soft red light was faded into a rose pink by the more intense brilliant white light from the projectors.

A beautiful effect is obtained when the lights are turned on at the approach of darkness. Promptly at sundown the red lights are turned on, which in the early twilight appears a faint pink. As the twilight gradually becomes darker, the colors come up to a rich red, which is again transformed into pink, by the white lights of the projector. Flood lighting lends itself admirably and economically to such illumination schemes. —*Photo by Courtesy of "Electrical World."*



An Artistic Triumph in Illumination Engineering. Flood Lighting of Court House at Stockton, Calif.

U. S. FIELD WIRELESS IN MEXICO INCREASED.

The power plant of the field wireless station at General Pershing's headquarters in Mexico was doubled recently, inaugurating one of the first of the military improvements suggested by the Mexican campaign.

The sending of naval wireless messages on both coasts of North America can be read nightly by this station, but on account of lack of sufficient power it usually has been unable to send even as far as Columbus at night. Daylight conditions are better for wireless operations, owing to the incessant rattle of static at night.

Several changes in the methods of handling the signal business in the field have been worked out during the two months' experience in Mexico. Division of labor is one of the suggestions.

In the rapid advance on Villa's heels, a single signal company sometimes was strung out over a length of 400 miles so that each man, instead of doing merely the portion of the work in which he was most expert, became a jack of all trades, doing everything from stringing wires over mountains, to copying telegraphic or wireless messages. The signal corps men met the emergency well, and it was pointed out that for real warfare many valuable lessons had been learned.

UNIVERSITY OF KANSAS WIRELESS COURSE.

A course in wireless telegraphy is to be added to the curriculum of the University of Kansas next year. Laurens E. Whittemore, a fellow in the department of physics, will conduct the course, and he intends to make the wireless station in Lawrence one of the largest in the state outside of those owned and controlled by the government.

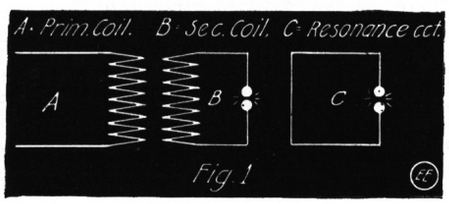
The present outfit established by Whittemore is capable of sending messages more than 1,000 miles and has picked up parts of messages from as far as Key West. The course is expected to prove extremely popular in the next two years.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

HIGH FREQUENCY PHENOMENA.

CURRENTS of high frequency and high potential exhibit many phenomena which are entirely different from those of ordinary currents. A discharge which would ordinarily be fatal, will not even be felt by

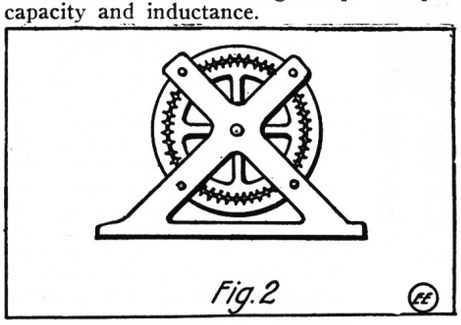


A Closed Wire Loop with Micrometer Spark Gap at "C," Enabled Hertz to Prove the Existence of Electromagnetic Waves in the Ether.

the body if it is of high frequency. An incandescent lamp may be short-circuited by a heavy copper bar and yet such a current will light it, while vacuum tubes may be caused to glow brilliantly without any metal connections at all. This, of course, does not at first seem reasonable until the phenomenon and conditions are explained.

By the frequency of a current is meant the rapidity of its alternations or reversals in direction. Joseph Henry, of Washington, first discovered that the discharge of a Leyden jar or condenser is oscillatory, and Sir Oliver Lodge was able to visibly analyze such a spark discharge by means of a rapidly rotating mirror. This gave him definite knowledge that each discharge, instead of being a single spark, was a quick succession of flashes in opposite directions, beginning with a heavy flash and rapidly dying down to zero. The discharge of an open induction coil will seldom exceed ten thousand alternations per second, while the discharge from a suitable condenser may range from a few hundreds of oscillations per second to several billion, depending on the capacity and inductance of the circuit.

These terms—capacity and inductance—may be more readily understood if they are likened to the elasticity and inertia of a vibrating spring. In either case both qualities must be present in order that vibrations or oscillations shall occur. As a spring swings past its zero to be pulled back in the opposite direction, so does a Leyden jar over-discharge itself, then redischarges in the opposite direction, and repeats this until the current falls away to zero. Such oscillations generate the familiar electromagnetic waves of wireless telegraphy, and because the oscillations rapidly die out so also do the waves, and we then say that they are strongly *damped*. From the above, one can see in a simple manner how the wave-length depends upon capacity and inductance.

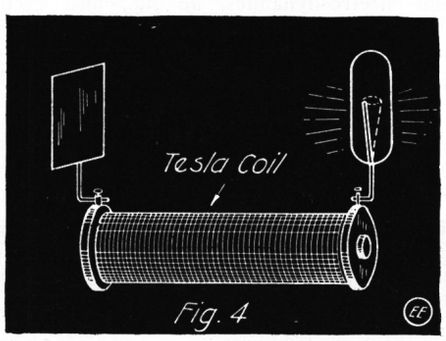


The High Frequency Alternator Produces High Frequency Current by Electro-Dynamic Means.

In order to create more permanent oscillations a source of constant and high potential may be shunted around the condenser, causing a continual process of charging and discharging. The first experiments along this line were performed by Dr. Hertz of the University of Bonn, who used merely an open induction coil. After their discoverer, they are known as *Hertz effects*.

While operating a coil with an exceedingly rapid vibrator, he noticed that sparks were jumping from several metallic objects about the room. By means of his resonator shown in Fig. 1, Hertz was able to prove that certain waves were sent out from the sparking circuit which could be caught by another circuit of proper wave-length, in which they would set up a *sympathetic* current capable of giving sparks. The best position for resonance was readily found by adjusting the length of the rectangle "C," and by placing it in different positions, the plane and direction of the wave was determined. The two circuits responded to each other just as two tuning forks of like pitch will respond sympathetically.

Following up these trail-blazing experiments, Nikola Tesla achieved fame by a number of more striking ones. Tesla determined to produce high frequency currents direct from the dynamo, and with this in view he constructed a number of machines, the plan of one of which is shown in Fig. 2, which he called *high frequency alternators*. The coils are very small and the poles hardly more than fine teeth. With such a machine Tesla was able to obtain a frequency of 10,000 per second,

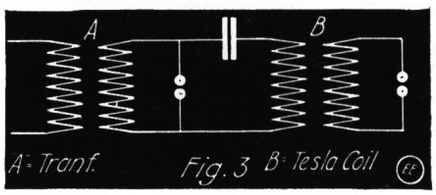


A Thin Wire Inside an Evacuated Tube and Connected to One Pole of a Tesla Coil, Will Rotate as Shown by the Dotted Lines.

and 10 amperes at 100 volts. The machine, small as it was, had 400 poles on the field, 400 coils on the armature and was run at 3,000 revolutions per minute. In a later machine a frequency of 15,000 per second was obtained. Since then others have labored in the same field, Duddell by using an induction disk with a fine toothed edge obtained at first a frequency of 50,000 per second and later the marvelous one of 120,000, although with the latter the current was reduced to .1 of an ampere and the voltage to 2 volts.

Professor Trowbridge, who was experimenting at the same time, produced sparks from 6 to 7 feet long from a condenser discharge which he calculated to be 3,000,000 volts! His method of obtaining such a voltage was simple but ingenious. Using 20,000 small storage cells, he charged the plates of a large condenser which were arranged in multiple. Reversing their arrangement he connected the plates in series and thus had an enormous potential though an exceedingly small current at his disposal. However, he was outdone by Tesla, who by his well-known Tesla coil or secondary transformer, produced a roaring spark of sixteen feet in length in 1900. He virtually reproduced lightning itself by a deafening discharge that crashed between electrodes a hundred feet apart. The voltage was in the billions and the current about 800 amperes.

The secondary transformer or Tesla coil used by him is shown diagrammatically in Fig. 3, where it is readily seen that the current from the induction coil sets up oscillations in the secondary circuit through in-



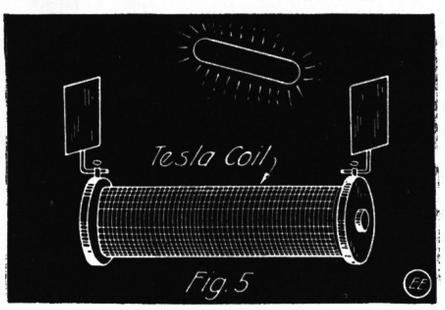
Tesla Scheme for the Production of High Frequency Currents

duction which are of both enormous voltage and very high frequency due to the capacity and inductance of the circuit.

The effect of such a spark on the body is peculiar. Where it strikes the body direct it may be more painful than the ordinary spark, but if made to strike an electrode of some metal touching the body or held in the hand, the whole discharge may be taken without any shock whatever. In such a situation sparks may be drawn from any part of the person and a gas jet may be lighted with the finger without even being insulated from the ground. To prove that an amount of current is really being conducted by the body, an incandescent lamp held in the hand, between it and the terminal, may be lighted.

Two probable reasons are advanced to explain the absence of sensation. In the first place an electric current starts to travel on the surface and spreads in a comparatively gradual manner to the interior of a conductor. When the successive impulses of the current are very short it travels *only on the surface* and therefore it is called the *skin effect*. Secondly, the sensory nerves of the body do not respond to such a short stimulus as probably the *millionth* part of a second.

The above mentioned skin effect is responsible for another statement at the beginning of this article. The larger a conductor is, the less will the current penetrate beneath the surface, and consequently the greater will be the resistance. This is at first a seeming incompatability, but a mathematical investigation will show the exact rule, that the effective resistance to a high frequency current varies *directly* as the diameter of the conductor. Thus if a current is passed through a very heavy bar, the effective resistance of the bar will be so great as to make it possible to light a lamp by touching its terminals only a few inches



An Evacuated Glass Tube Placed in the Electrostatic Field of a Tesla Coil Will Glow; the Forerunner of Wireless Lights.

apart upon the bar, although the lamp might seem to be virtually short-circuited.

Tesla labored long attempting to produce

(*Continued on page 375*)

Editor's Mail Bag

Under this heading are published communications from our readers of general interest to all concerned. In order that letters shall receive proper attention, we earnestly request you to make them as short and concise as possible. This is essential on account of the great amount of mail received daily.

No attention can be paid to unsigned communications, but on request we will withhold the correspondent's name.

EDITOR.

NEW ZEALAND'S MUZZLED WIRELESS.

Editor The Electrical Experimenter:

As a regular reader of *The Electrical Experimenter,* I feel in duty bound to let you know how much I appreciate your excellent publication. The paper has come rapidly to the front in a very short time, and I can safely say that it is one of the finest American periodicals of its kind that reaches these shores. What I particularly appreciate is the Radio Section, which deals with its subject in a really excellent manner.

As you are no doubt aware, wireless (that is, amateur wireless) is absolutely "kyboshed" in New Zealand. The penalty for owning radio apparatus or working an amateur station unlicensed by the Government is no less than £500, or in American coinage about $2,500, or as an alternative five years in the lockup. Truly a pleasing prospect for the potential amateur! How would some of your American amateurs like this?' Despite all this, a number of bold spirits had fairly well equipped receiving stations prior to the war, conducted with great secrecy. Of course all of this is absolutely stopped now that "the blast of war blows o'er the land" and New Zealand is at present practically under military control. However, I am, in spite of this, a very keen, though necessarily passive amateur, and hope after the war to establish a good transmitting and receiving station.

I take great interest in American radio apparatus and have the catalog from all the leading experimental supply companies and most of the English catalogs.

H. P. GIBBONS.

Wellington, New Zealand.

[*Our American amateurs, we believe, do not fully appreciate the great liberties they enjoy. New Zealand's wireless amateurs are not only muzzled in war times, but in peace times as well.—Editor.*]

ANENT THE AURORA BOREALIS.

Editor The Electrical Experimenter:

In your December, 1915, issue, under the Question Box, there is a contribution by Lawrence Madison, Kingman, Maine (379). I wish to state my own personal experience during the year 1909, that is, during the winter of 1908-9. I was then living at Portsmouth, N.H., and there was a very beautiful and spectacular display of the Aurora Borealis, which lasted for two or three nights, and I very well remember having discussed the peculiar hissing or crackling noise which accompanied this display at that time. This sounded very much like the crackling noise produced by the static (Wimshurst) machine. For at least two nights during this particular winter Mrs. DuEsler and myself went outside and noticed this very astonishing phenomenon.

Having lived in the east (New York State) for twenty-two years, I have quite often witnessed the ordinary display of the Aurora Borealis, but my New Hampshire experience was very much more impressive and more beautiful, as the lights flickered and seemed to be constantly changing in intensity and then decreasing in brilliancy.

Never before have I had the pleasure of witnessing such an unusual display accompanied by the crackling sound such as I heard back in New England during the winter mentioned above.

As you may see, my experience seems to be a repetition of those related by your subscriber, Lawrence Madison.

O. A. DUESLER.

Vallejo, Cal.

FROM A NEW SUBSCRIBER.

Editor Electrical Experimenter:

I am enclosing the voting blank you sent me the other day and wish to make a few remarks which cannot be placed on the card.

I particularly like descriptions of electrical and mechanical apparatus and circuits, provided that they are described in detail. I did not like the old *Popular Electricity Magazine* very well for the reason that they generally printed articles which were too elementary and anyone knew how the apparatus worked without reading the description. Those articles on apparatus which were not known did not increase the reader's knowledge because they were merely descriptions as an observer would see the apparatus in passing through the plant; very little, if any mention of the principle involved was made and no mention of the circuits, connections and specifications which would give one some idea of the operation. I like articles giving the operating theory of a piece of apparatus at least, and where possible a detailed description of the parts including the size, shape and size of wire, number of pounds or number of turns used, etc.

One of the things I would particularly like to see described in detail in the near future, would be the de Forest Ultraudion Detector-Type U.J.1. I understand this instrument receives both undamped waves and spark signals and I would like very much to get a diagram and explanation of the circuit used, especial attention being given to the difference between it and the ordinary Audion circuit. Also if any repeating or induction or resistance coils are used in addition to the regular Audion circuit, I would like to know the size and amount of wire used in them.

CHAS. KINYON.

Kansas City, Mo.

[*We are pleased to see that the presentation of our articles is appreciated. We try hard to print only constructive as well as instructive articles and as a whole, we believe we are succeeding.*

Regarding Ultraudion and Audion, etc., without wishing to boast, we believe this magazine has published more facts and articles concerning these instruments than all other journals combined. Full References will be found in the following numbers: May, Oct., Dec., 1913; April, May, June, July, Aug., Nov., Dec., 1915; Jan., Feb., March, May, June, July, Aug. 1916.

We would strongly advise new subscribers to secure all available copies of back numbers. These contain a wealth of important articles not to be found in print in any existing publications.—Editor.]

THE subscription price of this publication will be raised from $1.00 to $1.50 in a very short time. See our announcement in the July issue. If you wish to save money, now is the time to subscribe at the old rate: $1.00 a year, $2.00 two years, etc., and $5.00 for five years. (Foreign and Canadian add $0.50 per year for postage.) If you are a subscriber you will profit by extending your subscription for one or more years. No subscriptions accepted for a longer period than five years. ACT NOW, before this chance is gone.

ONE READER'S OPINION.

Editor Electrical Experimenter:

I was much interested in reading some comments in the "Editor's Mail Bag." I was one of your first subscribers away back in 1908, to *Modern Electrics.* You then printed "what the readers want and not what strikes the editor's fancy." It seems to me that if the editor succeeding you had not printed something that struck his fancy, *Modern Electrics* would have prospered to this day.

The average reader does not seem to know just what he wants. He gets a hobby for one thing and then for another. If he sticks to one certain phase of experiments, he becomes narrow-minded along another line.

I have been a subscriber for about a year to THE ELECTRICAL EXPERIMENTER. Before that time I bought the magazine now and then at the news-stands.

I have been more or less narrow-minded myself. I could not see, for the life of me, why it was that the editor continued the story of the "Baron Münchhausen's Scientific Adventures," but after reading a few installments I began to look at improbabilities with the far distant view of probability I am not much of a wireless fiend although I have a station. My hobby is chemistry. I am glad to see an entry of chemistry in the *E.E.* These first installments seem rather elementary, but in going over them, they certainly refresh my mind a great deal. Your treatise on "Electro Physics" is also of great interest as well as "The Constructor" and "How-To-Make-It" departments.

Many of the articles in the various departments I pass over, sometimes because I am not interested, and sometimes because I have seen similar articles before, but this fact does not lower my appreciation for the magazine because I believe that THE EXPERIMENTER is not published for me alone, but for thousands of others.

Last, but not least, your "Ad." section. I like your "ads" because they are brief, concise and right to the point.

How about it, Readers? Let's get together and make the old phrase "A big I am and a little you," read a "Big you and a little I am," and everybody for THE ELECTRICAL EXPERIMENTER, as a magazine to the interest of everyone.

Yours Electrically and Experimentally,

E. A. NORSTADT.

Joliet, Ill.

[*A constructive letter of value for the editor's guidance. We need letters such as this one and we believe our readers will appreciate Mr. Norstadt's views. The editor has a very difficult task trying to please everyone—there are so many tastes, so many likes and dislikes. Only by telling us your wishes, can we give you the magazine you want.—Editor.*]

RADIO DEPARTMENT

New Light Weight Radio Sets for Aeroplanes

SINCE the commercialization of wireless telegraphy, radio engineers have been trying to reduce the size and weight of the apparatus to make it better adapted to small vessels, field work and aeroplane scouting. Among the results of importance are those obtained by Messrs. Bowden Washington and Fulton Cutting, the well-known radio engineers.

The ¼-k.w. set, Figs. 1 and 2, is intended particularly for submarine and patrol boat work. The panel is of Bakelite. At the left is shown the antenna transfer switch, which changes the antenna from sending to receiving and opens the generator line when in the receiving position. The ammeter registers the current in the antenna circuit. When the set has been tuned to the aerial, a direct indication of the wave-length is given on the front of the panel. In the side view the secondary inductance is clearly shown. Both the primary and secondary coils are wound with Litzendraht cable. No variation of the primary inductance or the mica condenser is necessary when the wave-length of the aerial circuit is changed. The impact excitation of the secondary circuit makes this possible. During each successive half-cycle of the 700-cycle, 500-volt feed circuit, the condenser charges and discharges many times. Each of these discharges consists of a single loop or half-cycle, which may be considered as a blow to the oscillating circuit. The occurrence of each successive blow in proper phase relation to the antenna is insured by the following operation:

We will consider that the gap has just discharged, and set the antenna in oscillation. The condenser immediately charges again and reaches a potential almost sufficient to break down the gap before the wave-train in the antenna has died down perceptibly; therefore the E.M.F. induced in the closed circuit by the oscillating antenna adds a slight increment of potential at the proper time to "trigger off" the gap in phase. This is somewhat like tapping a punching bag and letting it swing back and forth a few times, and at just the proper moment tapping it again, thus keeping it in a practically continuous state of oscillation. These gap impulses naturally occur more frequently during the central part of each feed current loop, giving the antenna oscillations greater amplitude at this point. In fact, the tone envelope of the antenna wave-train is practically sinusoidal, giving a very beautiful note.

This is the best way to excite the antenna for two reasons; the perfect quenching of the gap insures a pure radiated wave, making a sharp tuning at the receiver possible. Since the primary circuit is so highly damped, the aerial vibrates at its own frequency, without respect to the wave-length of the exciting circuit. Thus it is possible to vary the wave-length of the antenna circuit without in any way changing the primary circuit or coupling, a great advantage in changing quickly from one wave-length to another.

In tests made on a ½-k.w. set, the phantom antenna capacity was changed through a ratio of 3 to 1, the secondary inductance from 2 to 1, and the primary condenser 2 to 1, yet the radiation current was changed only 10%. Under favorable conditions this type of apparatus has an efficiency of better than 70%, as against 40 to 50% in most spark or arc sets.

The gap used on these sets consists of two polished copper terminals in an atmosphere of alcohol vapor, the alcohol being supplied to the gap chamber by a wick. One of these terminals is movable, for the adjustment of gap length. The gap is very short, usually not more than four to six thousandths of an inch. Both electrodes are provided with large cooling fins, air cooling having been found sufficient. As the power in the sparking condenser is equal to

$$\frac{NCV^2}{2};$$

where

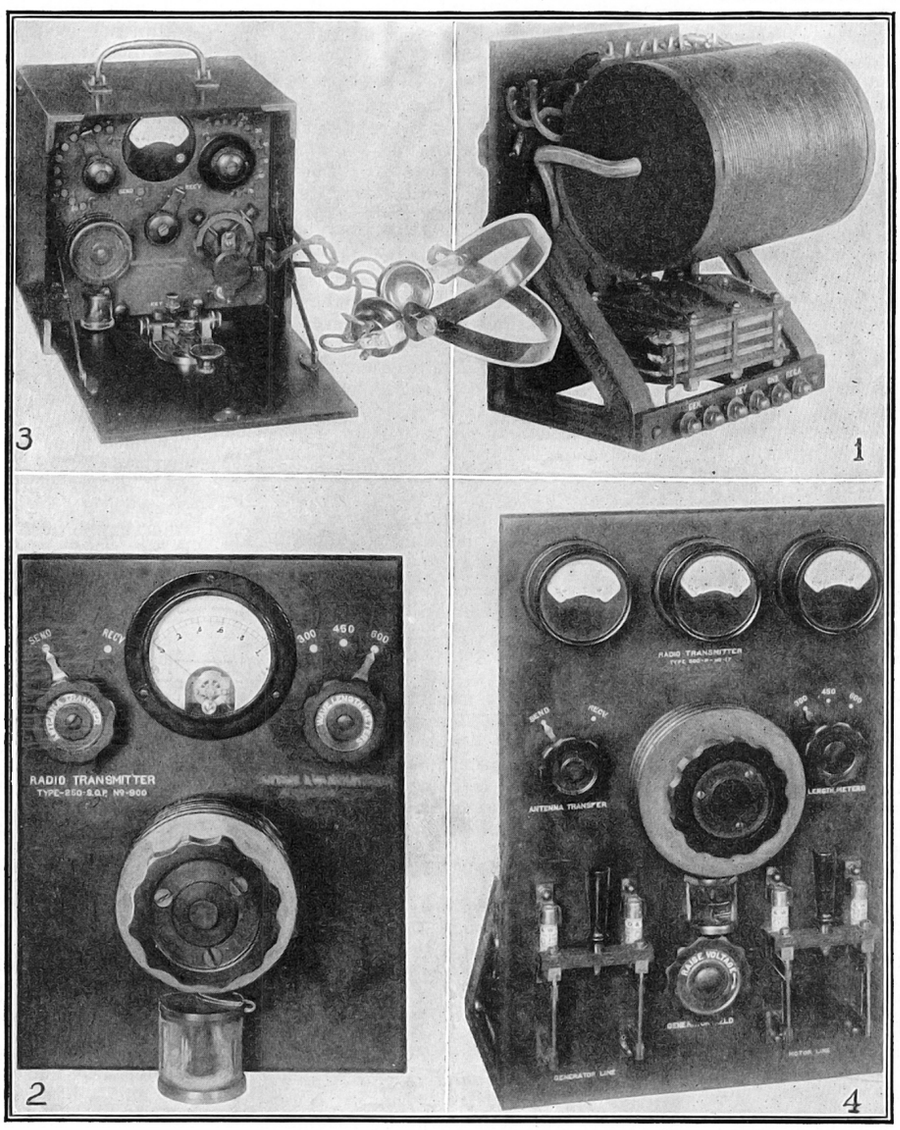
N=sparking frequency,
C=capacity, and
V=maximum voltage.

it will be seen that owing to the high spark frequency, many times that of the generator, as a great number of sparks occur to each cycle, much lower voltage is necessary than in the sets of the same power where only one spark occurs per loop. Here is another advantage from the point of view of reduced weight and bulk, since no step-up transformer is required, and the insulation is not as important as in high voltage sets.

The ¼-k.w. set, with an antenna 100 feet long and 60 feet high, consisting of two wires, has an average sending range of 150 miles.

In Fig. 3 a 1/6-k.w. aeroplane set is shown combined with receiving set. The weight of this set is 8¼ lbs., or 22 lbs. complete with a fan-driven generator, and an antenna consisting of a single trailing wire 150 feet long. The frame of the aeroplane is used as a capacity ground. A sending wave-length of 450 meters is used. The 15-point switch at the right

(*Continued on page 376*)



Several Views of Newly Developed Wireless Transmitting Sets of Extreme Value for Aeroplanes and Signal Corps Duty. They Operate on a New Principle, Utilizing a Spark Gap Across the Main Supply Circuit with Necessary Control Inductances, Condensers and Switches.

WIRELESS OPENS POLAR SEA ROUTE FOR RUSSIA.

Wireless telegraphy has opened a polar sea route from Central Russia to Great Britain. Wireless stations established by the Russian government in the Arctic keep the vessels advised as to the channels free from ice.

The Obi and Yenessi are huge rivers, with a great depth of water, taking steamers of any size, but it was not until lately that their navigation was put in practise.

SHIP RECEIVES 9,000 MILE WIRELESS MESSAGE.

The American steamship *Ventura* reports that she picked up a wireless message from the station at Tuckerton, N.J., when 9,000 miles distant from that point. This is said to be a world's record.

MOTORCYCLE RADIOPHONE.

The accompanying photographs illustrate a very efficient portable radio telegraph and telephone outfit, carried on a special motorcycle chassis. This compact little radio unit was developed especially for military work by Dr. Lee de Forest.

The transmitting end of this outfit consists of a special double arc quenched gap, on the panel of the rear partition of Fig. 1. The instrument at the right of it is the generator field rheostat. The condenser is of the glass dielectric type enclosed behind the quenched gap. The helix or aerial loading inductance consists of a spiral copper conductor, also mounted in the same compartment. The key on the cover is used for telegraphic sending. The radiophone is composed of the same transmitting outfit, namely, the arc, condenser and helix, which are used for generating the sustained waves, with the exception that a double microphone transmitter is interposed in the aerial circuit instead of the telegraph key. This microphone is at the right of Fig. 2. They are connected together with a single horn so that both are operated simultaneously when put in the telephone circuit. A hot wire ammeter is connected in series with the ground lead to indicate the amount of current radiated by the set.

The current for the arc is supplied from a 500- to 600-volt direct current generator, driven by a two-cylinder gasoline engine, on the same chassis as illustrated in Fig. 1, although the generator is not shown. A large fan is employed for cooling the engine, so that the set can be operated for a considerable length of time without overheating the engine. The dynamo is connected through a large choke coil to prevent the high frequency current developed by the oscillating arc from backing up through the generator. This is mounted on the panel back of the generator. Various other protective devices are included with the outfit.

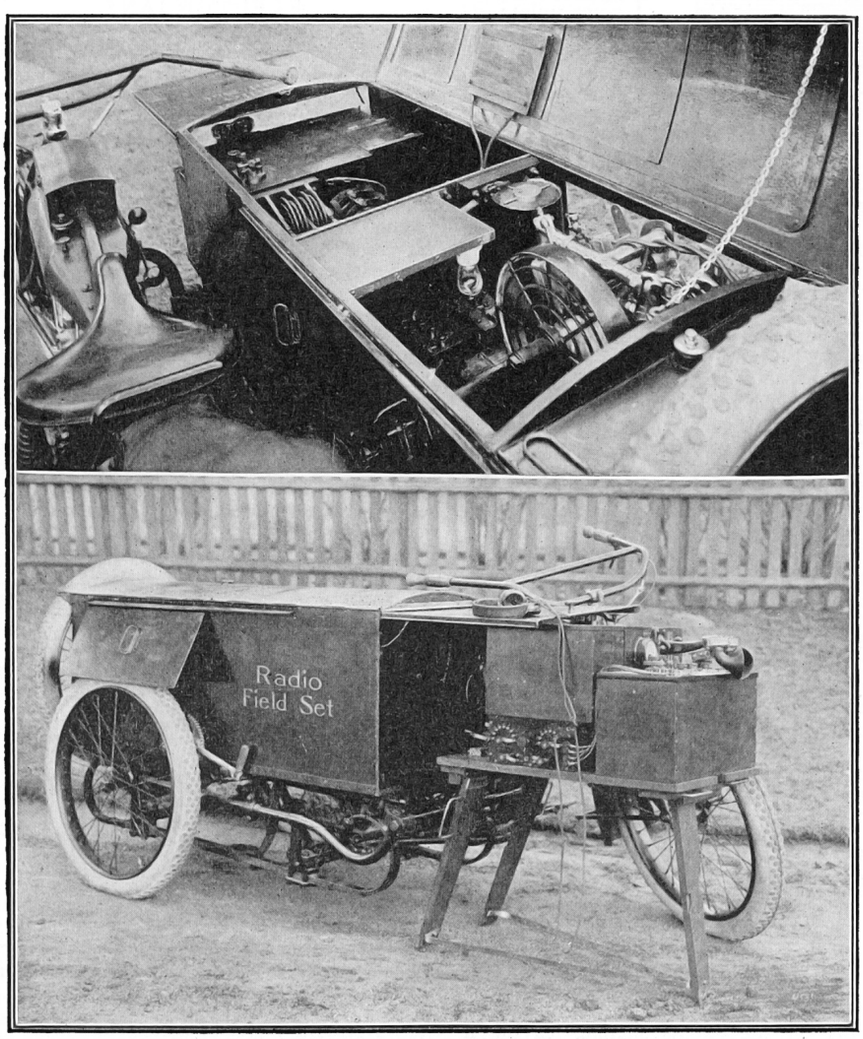
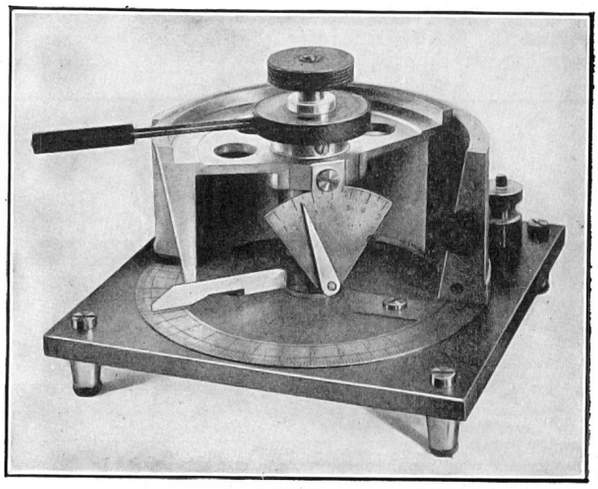


Fig. 1. (Above): View of Motorcycle Engine and Radiophone Generator.
Fig. 2. (Below): The Radiophonic Receptor and Large Microphone for Controlling Arc Current.

A CONICAL VARIABLE CONDENSER.

A very ingenious little condenser has recently been developed by Eugene T. Turney, the inventor of the Crystaloi detector. It consists of two semi-circular cones, one of which fits within the other. These are moulded of special metal composition and are of rugged construction. The inner cone is mounted on a mandrel, supported on a threaded rod so that the inner electrode can be raised or lowered by turning the upper rubber knob. In this way the capacity of the condenser can be varied as the distance between the two metallic surfaces is altered, thus changing the dielectric space, which, of course, changes the capacity. The movable cone is turned by handling the lower knob. A pointer is fastened on one edge of the semi-circular electrode, which plays over a graduated scale as perceived.



New Variable Condenser for Radio Receiving Circuits. The Inner Cone Turns and Also Rises Within the Outer Cone. Provided with Calibrated Scales.

Seven different capacities can be obtained by varying the position of the movable cone with respect to the stationary. Several hundred graduations of capacity are obtainable, however, by utilizing both lateral and vertical adjustments of the rotatable inner electrode. The scale and pointer mounted on the movable electrode indicates the lateral position of the cone.

The complete condenser is mounted on an insulating base, fitted with two binding posts for making connections. This condenser is, perhaps, the only instrument that will give more individual capacities than any other of its construction and size. It is suitable for laboratory work where many different exact capacities are required.

The receiving instruments consist of an Ultra-Audion, capable of receiving damped and undamped wave stations. The detectors controlling the apparatus are on the lower left side of the stand, Fig. 2. The two multiple switches on either side are employed for varying the high voltage current in the detector, while the knob in the center controls the current through the filament. The two double-point switches on the bottom control the Audion tube, so that it can be used for either receiving sustained or damped wave stations.

The aerial loading and condenser apparatus are enclosed in a separate box, which is seen at the right, below the microphone. This cabinet contains one loading coil, taps from which are brought to a multi-point switch placed on top of the cover. The cacapacity of the set consists of two large variable condensers which are controlled by knurled rubber handles projecting above the cover. These instruments and the vacuum detector are connected by means of four

(*Continued on page 376*)

HIGH TENSION CONDENSER SWITCH.

The illustrations are quite complete and so detailed explanation seems unnecessary. By a close study of Figs. 1 and 2, the construction of the switch will be readily understood. The letters refer to the same parts in each figure.

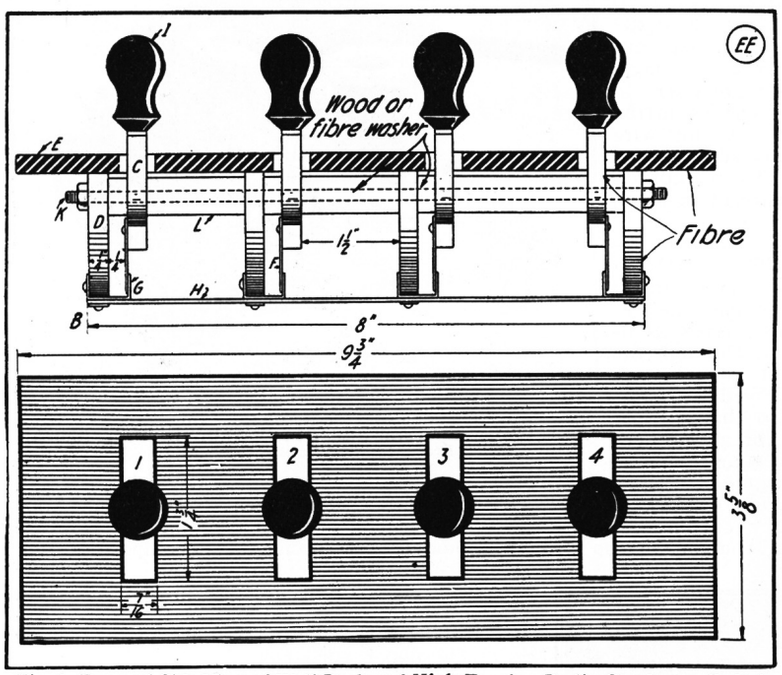


Fig. 1. Top and Side View of Well Designed High Tension Radio Condenser Switch. Handles have a To and Fro Rocking Motion, Movement of Hand Being Very Small.

A_1, A_2, A_3 and A_4 are terminals to be connected as indicated.

B is terminal to be connected as indicated.

C is of fibre, exact shape shown in Fig. 2.

D is of fibre 2¾" long, 1-11/16" wide.

E is of fibre 9¾" long, 3⅜" wide.

F is of copper fastened to C with machine screws.

G is a copper or brass shoe bent as shown in Fig. 1.

H is copper or brass strip to connect all B terminals.

I is of ebony or some other hard wood turned as indicated.

J is of copper or brass bent to come in contact with F.

K is a brass rod threaded and has a nut on each end.

L represents wooden washers to separate D and C.

In switching in various condensers sections the following schedule is useful:

For 1 plate use No. 1.
For 2 plates use No. 2.
For 3 plates use No. 3.
For 4 plates use No. 3, 1.
For 5 plates use No. 3, 2.
For 6 plates use No. 3, 2, 1.
For 7 plates use No. 4.
For 8 plates use No. 4, 1.
For 9 plates use No. 4, 2.
For 10 plates use No. 4, 2, 1.
For 11 plates use No. 4, 3, 1.
For 12 plates use No. 4, 3, 2.
For 13 plates use No. 4, 3, 2, 1.

This switch may be used to good advantage in sets of almost any size. Its electrical capacity may be greatly enhanced by immersing the switch gear in transformer oil. Also a second contact may be mounted on D, opposite contact A, thus doubling the utility of the design here proffered.

Contributed by ERNEST OKE.

REGARDING TIKKERS FOR UNDAMPED SIGNALS.

There have been numerous descriptions of tikkers given in the various magazines. While some of the designs are very good, there are others which have their disadvantages. For instance, all tikkers which depend upon alternating current for their action, such as "relay tikkers," will work only when the sending station is relatively nearby. This is due to the interference caused by the alternating current hum. It is much more noticeable when using the sensitive mica diaphragm 'phones. Then there is the type of tikker which uses a small battery motor to rotate a wheel, either commutator or grooved pulley, with a wire resting in or on it. This type has the following disadvantages: the spark at the brushes of the motor, however small, will be distinctly audible and prove a nuisance unless especially guarded against. Theoretically it can be overcome by making a tuned circuit of very short wave-length of this spark by shunting it with a small inductance and capacity in series, but no case in which it has been done with success has come to my notice. The tikker which I use and which is described herewith overcomes all of the foregoing deficiencies.

The first thing to procure is an old phonograph motor, the cylinder type being preferable. I purchased mine at a second-hand store for a very small sum. Remove everything but the motor and the screw which controls the speed by adjustment of the governor. Next procure a wheel between two and four inches in diameter with as many cogs on it as possible. The brass driving wheel from an old magneto, which has about 180 cogs, will do very well. Fill the spaces between the cogs with shellac so that the brush will run smoothly. This is done by using thick shellac and allowing each coat to dry by baking it before applying the next one. When the shellac is thick enough to cover the cogs, bake it well over a *slow* heat so it will not melt and run. After it is well hardened file off the excess shellac, leaving a perfectly smooth wheel with alternate segments of brass and shellac.

Secure the wheel by a suitable bushing to the shaft of the motor which formerly turned the record spindle. After arranging a small strip of spring brass to act as a brush, the tikker is ready for use. The reason for using a wheel with many cogs is obvious. You may run the phonograph motor at a very low speed which will allow it to run a considerable length of time and still give a fairly high note in the 'phones.

Contributed by W. A. PARKS.

SHIP OPERATOR HEARS MANY AMATEURS.

In this and many other magazines I have read of amateurs who made claims of exceptionally long distance work in sending and receiving. Being an operator on a third-class ship, I thought I would tune for a 200 meter wave and see what came in! The results astounded me! I heard a great many stations and following is the list of stations which came in loudest on each of three successive evenings: January 17, 1916, ship's position 100 miles southwest of Diamond Shoals Lightship, at 11 p.m., copied 2SX (New Rochelle, N.Y.), working 8 MW. Distance about 480 miles. January 18, 1916, 11:10 p.m., 300 miles southwest Diamond Shoals, copied 8 NH (St. Mary's, Ohio), working 8 QB. Distance 650 miles. January 19, 1916, 10:30 p.m., eighty miles north of Jupiter, Florida, copied 8 AEZ (Lima, Ohio), working 8 OU. Distance 900 miles. No special apparatus was used in receiving, a Telefunken receiver and a galena catwhisker detector being used.

Contributed by S. TONNER.

TIMELY HINTS TO ELECTRICIANS.

An electrician who is not familiar with or does not follow accepted standard practice in his repair and installation work is a constant menace to the safety of any establishment and its employees.

Shield your eyes from electric arcs or flashes. This kind of light frequently causes temporary blindness and in some cases ruins the eyesight. If you ever become so affected, consult your physician at once.

Small cuts, bruises or burns should receive treatment immediately and be protected from dirt or mechanical injury. Blood poisoning may set in and must be guarded against.

Keep your eyes on your hand when reaching for electric switches. Otherwise you may touch the "juice."

Before working on electric machines *lock* the service line switch *open* and place the key in your pocket. No person can then turn on the current with fatal results to yourself. This has often occurred.

Screwdrivers, pliers and all other handy tools should have insulated handles.

Immediately stop any abuse or misuse of electrical apparatus.

Never work on live circuits unless it is absolutely necessary. If you must work on such circuits, use all the safety devices and methods possible.

Treat all wires as "live" until you are absolutely sure they are "dead."

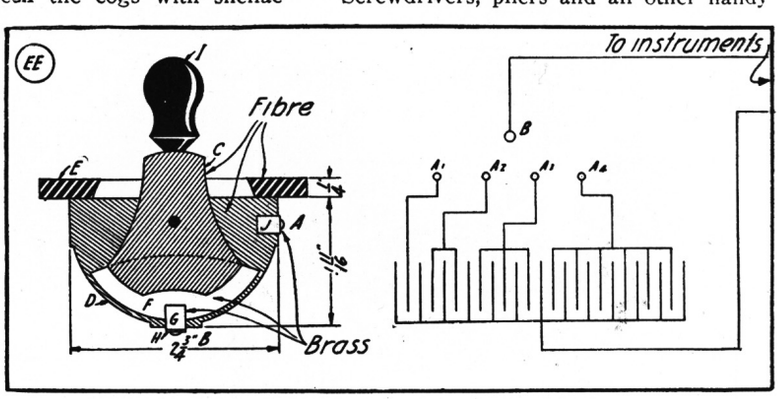
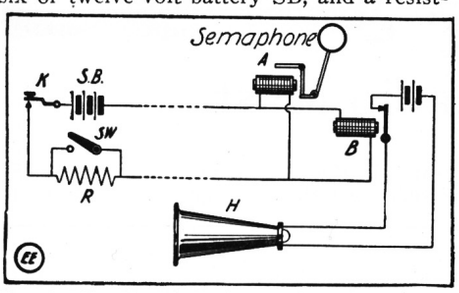


Fig. 2. Details of High Tension Condenser Switch, Including Connections Giving Various Capacities.

A SIMPLE TIME SIGNAL.

The following is a description of a simple arrangement for sending out time received by wireless. Such a system as this is in use at the University of Iowa.

The necessary parts are a semaphore A, a relay B, an electric horn H, with two or three dry cells to operate it, a key K, a six or twelve volt battery SB, and a resistance R, arranged so that it can be short-circuited by the switch SW. The relay is wound so that it will operate on a smaller current than will the semaphore. The value of the resistance must be such that, when in the circuit, it will limit the current to such an amount that the semaphore will not be tripped and yet will allow enough to flow to energize and close the relay. The proper value can easily be found by test. If it is not possible to obtain a small semaphore, one may be made from a telephone drop such as are used on the magneto type of switchboard.



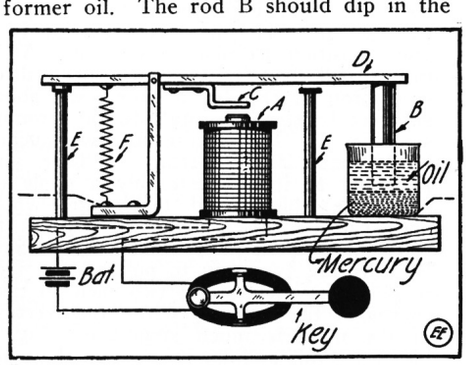
Pressing Key K with Resistance Switch SW Open Closes Relay B, Operating Horn H. On the Hour SW Is Closed, Key Then Operates Semaphore A.

The following method of operation was found by trial to be the most satisfactory. When the time signals are received the operator presses the key and gives a long warning blast on the horn at one minute to the hour. At ten seconds to the hour a shorter blast is given. Then the switch S is closed and exactly on the hour the key is pressed again, causing the semaphore to fall and the horn to sound at the same time.

Contributed by RE.

ANOTHER OIL-BREAK KEY.

The telegraph key here illustrated is capable of handling the heavy currents used in wireless transmitting. It consists of a pivoted arm, D, made of brass or copper, with a copper contact rod, B, at one end. The soft iron armature, C, is screwed to the underside of D and is attracted by the magnet (or magnets) A. These may be taken from an electric bell. The contact rod B dips into mercury contained in a small seamless brass or glass receptacle. Over the mercury is poured a little transformer oil. The rod B should dip in the mercury about 1/16". A small coiled spring can be used to break the contact. The stops E, E, should allow the arm to swing about 3/16". An ordinary telegraph key is connected in series with two dry cells and the magnet A.



Oil-Break Key for Handling Heavy Currents. It Can Be Made From Odd Parts at Slight Expense.

This key will handle, if necessary, the current for a 1 K. W. transformer. It may also be used with a break-in system by arranging auxiliary insulated contacts on the arm D.

Contributed by G. W. COOKE.

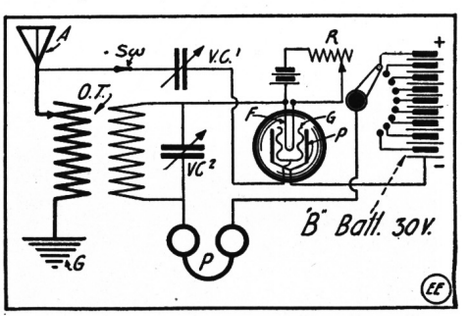
AN ULTRAUDION HOOK-UP.

By L. M. Westcott, U.S.N.

A receiving set using an aerial composed of six wires, 60 feet high and 100 feet long, has covered a distance of 4,800 miles at night, using the apparatus described in this article. The day-light range is ordinarily 2,000 miles when receiving from high powered stations.

The Audion detector used with this set is the ordinary second step amplifier bulb, having two plates and two grids. The unique part of this receiver is the connection of the grid to the antenna, through a variable condenser. A switch is employed, however, to open the circuit when undamped oscillations are being received. For undamped stations this connection is used. When receiving from the ordinary spark transmitters, this type of connection is equal to any of those on the market.

Experimenters using this circuit may encounter a slight amount of trouble in tuning, but a little experience will give results that are quite surprising. The adjustments are very delicate—a slight adjustment of either the primary or secondary will throw the set completely out of resonance. It is absolutely necessary that the primary and secondary windings are adjusted to the same wave length to make the bulb oscillate properly when receiving undamped waves. This is easily accomplished after a little practice, for when the bulb is oscillating a slight hissing and popping noise may be heard in the receivers.

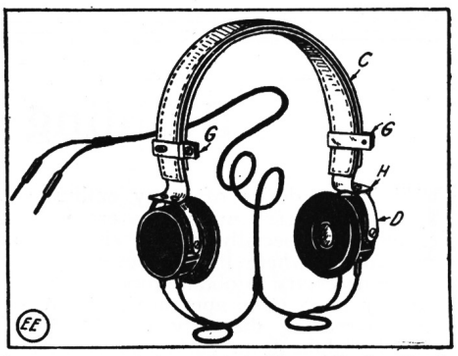


An Ultraudion Hook-Up Worth Trying on Your Set

The tuning of this outfit is different from the ordinary Audion. The fine tuning is done by means of a variable condenser and the primary switch, with little variation in the coupling. A loose coupler for receiving waves up to 10,000 meters has a primary coil 7 inches in diameter and 14 inches long wound with 700 turns of No. 26 single silk covered wire. The secondary is 6 inches in diameter, wound with 1,000 turns of No. 30 single silk covered wire. When the condenser V_2 has a capacity of approximately .0004 M.F. this set will tune all stations up to 10,000 meters. The condenser V_1 should have about the same capacity. For long waves the secondary should be about half way in the primary, but for short waves the coupling must be very close. Taps on the secondary should be about 50 turns apart to allow for close tuning with the shunt condenser. The bulb will oscillate best when using about 25 volts of the "B" battery. Ordinarily it is burned at medium brilliancy, that is, consuming not over ½ ampere.

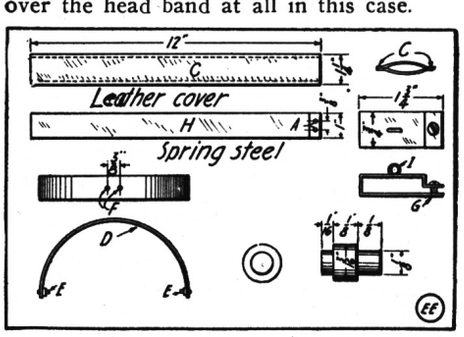
An interesting characteristic of this set is the similarity of the tone which it gives to the incoming spark frequencies from 100 to 500. Over this range there is little difference between the pitch or tone of the signals. Arc signal frequencies can be changed at will by a slight variation of the coupling or the variable condensers. This receiver has been used with very good results in connection with radiophone work.

AN ADJUSTABLE HEAD BAND FOR 'PHONES.



Appearance of Assembled Home-Made Head-Band for Radio or Telephone Receivers

For those who have no head band to hold their 'phones a simple one can be made from a clock spring. The spring I used was from an old alarm clock and measured 1 inch wide. This head band will require two spring strips, each 12 inches long by 1 inch wide. At the end of both strips two ⅛-inch holes A, each ⅜ inch apart, are drilled (first annealing the spring) and the end bent upright as shown. A cover is made for these two strips, by sewing two pieces of leather 12 inches long and 1¼ inches wide together, along their edges C. Two metal strips, each ⅜ inch wide and a little longer than half the circumference of the receiver, are drilled with two small holes F, each ⅜ inch apart, and tapped to receive a small screw. These pieces are bent to form half a circle D. The two ends of D are fitted with two pivots E E, which are riveted into a ⅛-inch hole. Two holes are bored in the side of each receiver. The pivots E E fit into these holes and form bearings in which the receivers can turn and thus automatically adjust themselves to the ear. The pieces D are held to the strap H by two screws which pass through A. The leather covered bands are made adjustable for any head by means of two clamps G. Their form and construction may be best understood from the drawing. A small screw eye is cut in half and soldered to the center of the clamp so that the receiver cord may be passed through the eyelet. If you connect the receivers as shown, you can omit the screw eye on the clamp, as the flexible cord does not go over the head band at all in this case.



Parts Making Up Home-Made Head-Band Including Leather Cover for It.

Contributed by AN EXPERIMENTER.

Do you believe in Female Radio Operators for the future? Well, whether you do or not, see what you think of the situation after reading our interesting article, *The Wireless Girl*, in the *October* issue.

THE CONSTRUCTOR

Building a 110-Ft. Iron Pipe Radio Mast

By Samuel Cohen

IT is the desire of many enthusiastic radio experimenters to erect high aerials, especially when situated in localities where highly elevated masts are necessary to obtain good all around efficiency from their apparatus. However, masts exceeding the fifty foot limit are somewhat difficult to build and erect, and this work is properly intended for riggers, although they cannot always be obtained. The purpose of this article is to tell the amateur how to build and erect a 110-foot radio mast.

The mast consists of seven sections made from galvanized iron pipes of decreasing diameters. Each measures 16 feet long, except the last or highest, which is fourteen feet long. The diameter of each pipe is given in the diagrammatical sketch, Fig. 1, which illustrates the general layout of the mast. Each pipe is connected with the adjacent ones by means of stock reducers, the sizes of which are also given in the drawing. The lower part of the three-inch pipe is fitted with a tee, in which is fitted an iron plug C, pointed as shown. This is made by procuring a three-inch pipe, about two feet long and shaping it o a point, by placing it into a blacksmith's furnace and heating it to redness, then hammering the end until the proper shape is secured. In the side opening of the tee at B, a three-inch pipe A, about sixteen feet long, is fitted. This is used for erecting the mast when it is completed.

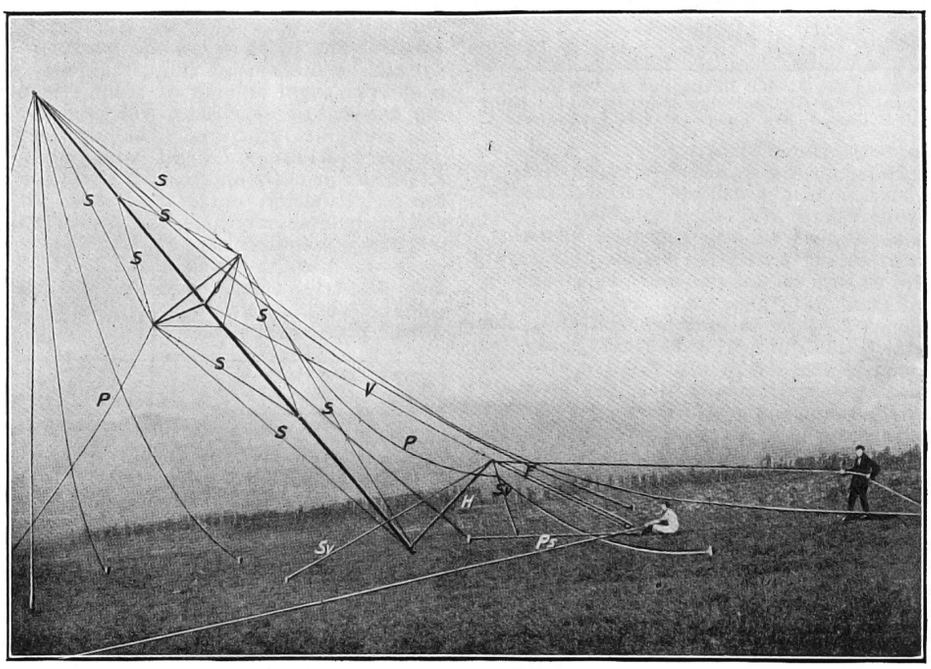


Fig. 4. The 110-Ft. Iron Pipe Mast Being Raised by Two Men. Details of Construction Given Herein

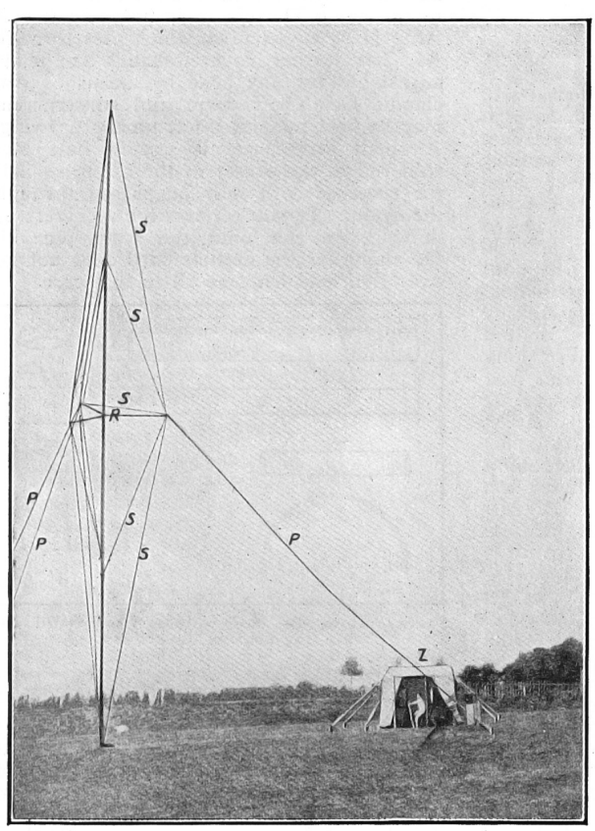


Fig 5. The 110-Ft. Iron Pipe Mast Fully Erected and Radio Station in Tent.

The central portion of the pole is fitted with a three-way tee, D. Three 1¼-inch pipes, E, E and E, are obtained, six feet long. These are fastened in the openings of the tee. The ends of these pipes are secured with standard malleable iron eyehooks, F, F, F, to hold the guy wires. This section of the mast can be seen in the top view, Fig. 2. Each pipe is placed at 120° angle from the adjacent one.

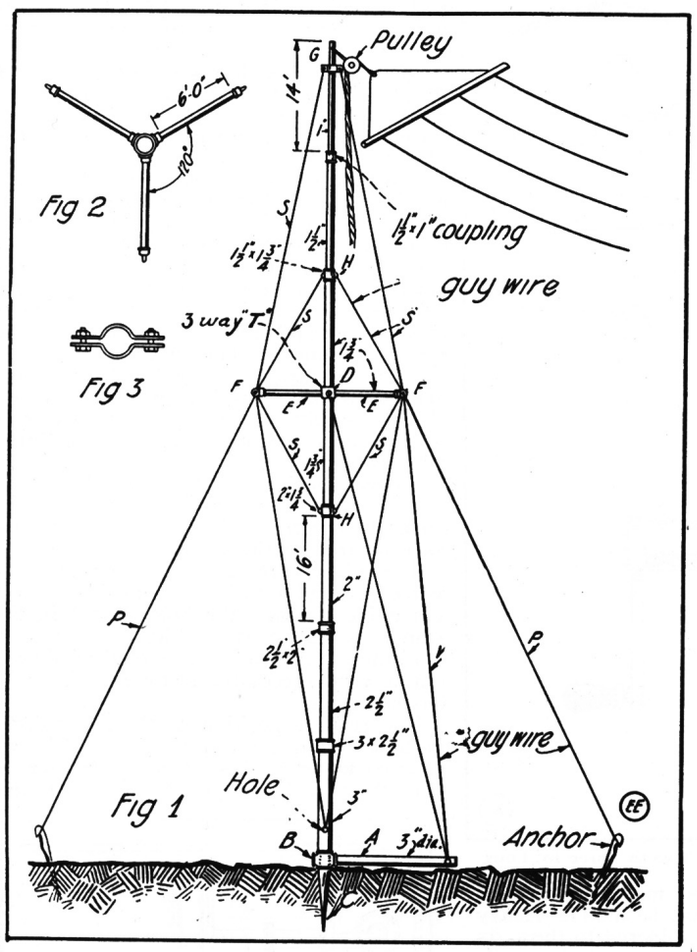
When all the pipes are ready, the next step is to assemble the mast and thoroughly guy the various points along the mast. Before rigging up the parts, the reducing couplings should be properly covered with white or red lead, to prevent the formation of rust on the threads. It is advisable to construct four wooden horses for supporting the various portions of the mast when assembled. It will be found worth while to build them, as it will save a considerable amount of time and labor. The next step to be taken up is to guy the various portions of the mast and also fastening securely the support guys. First construct three guy hooks, Fig. 3. These are made from ¼-inch galvanized strap iron, bent in such a manner as to fit tightly around the pipe. They are held together by two ¼-inch machine screws. Galvanized guy cable, 5/16-inch diameter, is connected to the various points as illustrated in Fig. 1. All the guys marked "S" should be tightened, and care exercised to see that the shape of the mast is not altered when the guys are tightened. It is thus advisable to use turn buckles if the cable is to be properly adjusted. The three lower guy wires are fastened to the mast by passing them through a ⅜-inch hole drilled through the pipe. The support guys P, P, P, are about 100 feet long. The next thing is to paint the mast with three coats of heavy lead paint, of a color to suit the builder best.

The experimenter may think the work of erection difficult, but he will not find it so if the following directions are properly carried out. The first requirement is a good position to place the mast. At a radius of 80 feet from the mast drive three stout iron or wooden anchor posts about six feet long, at an angle to the ground, see Fig. 1. By placing another anchor block about 20 feet from the base, and fastening to it a (preferably a triple or quadruple) block and tackle the whole mast can be raised about 15 degrees to start the pointed plug C into the ground. By allowing two men to pull on the free rope of the tackle, and two men to take charge of the free guy wires, the erection of the mast is much simplified. Fig. 4 illustrates this angular position of the mast when the hoisting was started. The man to the extreme right had charge of a swinging guy cable, which helps to support the mast, as it will be found that when the pole is in an angular rising position, it manifests a tendency to swing around, and will have an inclination to fall. It is also advisable to employ a couple of swinging (free) guys fastened to base extension A. By continuously pulling on the tackle rope, it will be found

that no difficulty will be encountered in erecting the pole. In fact it should not take more than one-half hour to set the mast in a perpendicular position. The various guys are then firmly secured on the anchor blocks. Two short pins are forced into the earth on either side of pipe A, so that the whole mast does not tend to turn.

The complete erected mast is illustrated in Fig. 5, with the radio operating room at the right. The latter was built out of pipes and canvas. The rapidity of erecting such an antenna makes it extremely satisfactory for field and portable use, if the various sections are made light.

The radio experimenter will find the erection of a high aerial mast as described above very efficient, satisfactory, and low in cost, which is perhaps the most important item to the amateur.



Details of 110-Ft. Radio Mast Composed of Progressive Sizes of Standard Iron Pipe, Joined Together by Reduction Bushings.

REMOVING ENAMEL FROM MAGNET WIRE.

Although there is a certain prejudice against the use of enameled wire for tuning coils and couplers, many operators prefer this kind of wire. There is one great trouble experienced when winding coils with the finer sizes. It is that the wire itself is scraped and often broken in removing the enamel. The only way to remove the insulation without injuring the wire is to pass the wire quickly through the flame of a bunsen or alcohol burner, so that the enamel melts and drops off. A slower way, but better for the smaller sizes, is to dissolve it in amyl-alcohol. This method is also useful when wire is to be accurately measured by micrometers or calipers in the work-shop.

Watch for the "Wireless Girl" in next issue!

A UNIQUE ELECTRICAL CENTERPIECE.

By P. C. Grose

A young bachelor wished to entertain three of his lady friends at a little dinner which he sought to make extremely novel. A unique centerpiece which he originated greatly enhanced the effect he desired.

From a library-table lamp the shade was removed. A large cylindrical shade was constructed to take its place. Being made of paper and cardboard, this was light enough to have its entire weight rest upon the little conical point of glass at the extremity of the electric light bulb. The top portion of the shade was made of stiff round cardboard. In the center of the under side of this disc a small piece of dented tin was attached so as to rest on the point of the bulb. Around this central point, extending laterally from it, a series of triangles were marked and spaced so that when each was cut on two adjoining sides and bent downward into the interior of the shade at an angle of about 45 degrees, the effect would be a horizontal windwheel. As the lower part of the shade swung free of the lamp pedestal, the only contact at all being the glass point and the dented metal, there was so little friction that an almost imperceptible atmospheric current passing through the windwheel would cause the shade to slowly revolve. The upward flow of the heat from the enclosed electric bulb produced such a current.

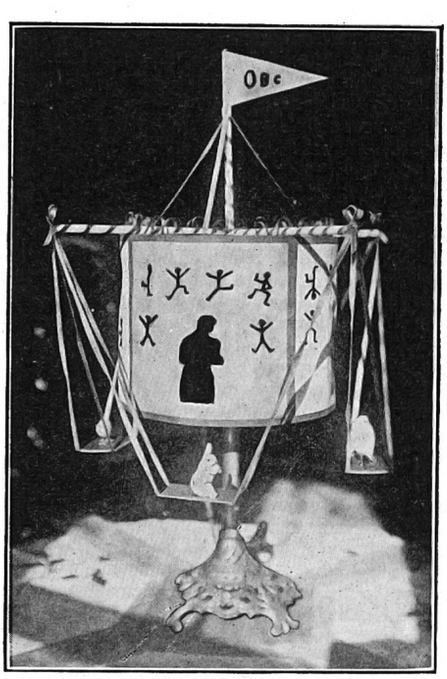
The outward part of the shade was divided into four equal sections. A different color of heavy bond paper was used for each section. From a freak kodak picture an enlarged silhouette drawing was made of each one of the party. These were cut from heavy black paper and one pasted in each section of the shade.

Using the "Dancing Men" code, described in the chapter "The Adventure of the Dancing Men" of A. Conan Doyle's "The Return of Sherlock Holmes," the first six letters of the christian and surname (the latter only when the first had less than six letters in it) of each member of the party were placed in the respective sections. They, too, were cut from the black paper and pasted onto the bond. As "dancing men" for only part of the letters of the alphabet are shown in the chapter mentioned, imagination served in creating additional ones when a name required it.

A little pennant surmounted the shade while from four lateral arms ribbons supported toy animals, each of these being the favorite pet of the person in front of whose section it swung.

When lit up and slowly revolving, it had a mellow, subdued impressiveness. The endeavor of the guests to determine which of the pictures and names was their own while revolving before them formed one of the interesting features of the dinner.

Lingering over the last course, the dinner ended merrily with such questions (the members took turns in suggesting them) as "Which one of us will die wealthy?" "Which one of us is a thief?" "Which one of us will be the first to marry?" The answer to each question was obtained by turning off the current to the lamp in the centerpiece. The one to whom the pennant most nearly pointed when it had stopped was the "victim."



This Novel Table Decoration Revolves by the Heat Liberated From 32-C. P. Bulb.

A SIMPLE WIRE GAUGE.

Drive a ¾ inch nail into a block of wood until it projects exactly ½ inch. Wind the wire of unknown gauge tightly around the nail and count the number of turns; double it, then refer to the table here given. For the smaller sizes it is only necessary for the nail to project ¼ inch; then the number of turns must be multiplied by 4.

Size B. & S. Gauge	Turns Per Linear Inch				
	Enameled	Single Cotton	Double Cotton	Single Silk	Double Silk
20	29	25	23	27	26
21	32	28	26	31	29
22	36	31	28	34	32
23	41	34	31	38	36
24	45	37	33	42	39
25	51	41	36	47	43
26	56	45	38	52	46
27	64	49	42	57	52
28	71	54	45	63	56
29	79	58	48	70	62
30	88	64	52	77	67
31	100	69	56	85	72
32	112	75	60	93	78
33	134	81	64	102	84
34	140	87	68	112	91
35	156	94	73	120	97
36	173	101	78	130	104
37	201	108	84	141	110
38	225	115	89	151	117
39	256	122	95	163	123
40	288	130	102	178	129

DOUBLE COTTON

Size B. & S. Gauge	No. Turns Per Linear Inch	Size B. & S. Gauge	No. Turns Per Linear Inch
4–0	1.70	7	6.08
3–0	2.00	8	6.80
2–0	2.32	9	7.64
1–0	2.65	10	8.51
1	2.99	11	9.56
2	3.36	12	10.60
3	3.80	13	11.88
4	4.28	14	13.10
5	4.83	15	14.68
6	5.44	16	16.35

Contributed by ALBERT CONRAE.

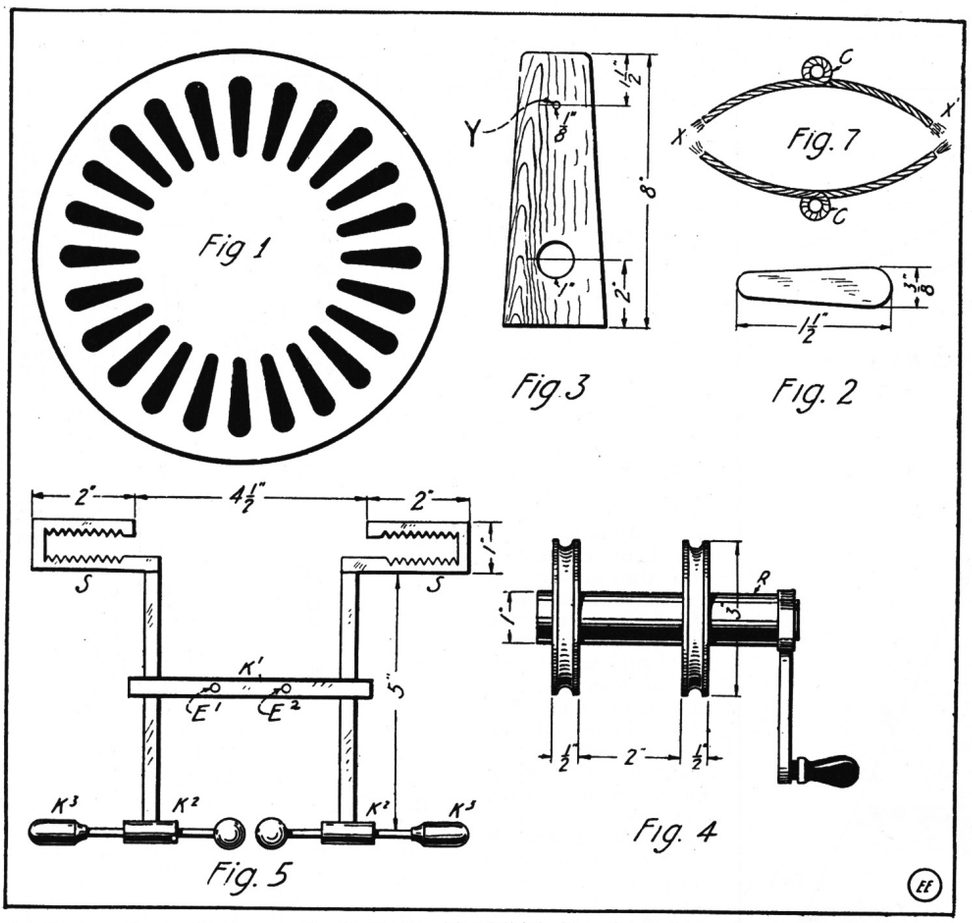
A Small Static Machine

By Leonard R. Crow

The static machine shown in the accompanying illustrations is capable of producing a 2½ to 3 inch spark and may be constructed at a very small cost; in fact, at almost no cost.

The size of the base may be as the builder desires. All that is necessary is that it be large enough to hold the uprights firmly, shown in Fig. 3.

We now come to the collecting combs.



Details of an Unusually Inexpensive Static Machine Which Gives Sparks from Two to Three In. Long.

First procure two phonograph disc records that have been worn out, each to be 8 inches in diameter. Divide the discs into 24 equal segments, marking all the divisions. This should be done on the smooth side of the record. Next the plates should be covered with shellac and thoroughly dried. As soon as they are dry repeat the process.

In the meantime 48 small pieces of zinc or zincfoil should be prepared, zinc is preferable if procurable. If neither is to be had, heavy tinfoil may be used. These pieces should be cut into the shape shown in Fig. 2 and the dimensions indicated should be carefully followed in cutting.

When the plates are perfectly dry give them another coat of shellac, and while still wet place the pieces of zinc with the narrow ends toward the center of the disc, on the previously made radial marks, as indicated in Fig. 1.

The next step is to turn from wood two small pulleys measuring 1 inch in diameter and 1½ inches in length. If access to a lathe cannot be had the builder may make these by hand, but in this case he must be very careful to make them perfectly round. With extra thick shellac stick these pieces on the plates over the holes that are in the center of the records, being very careful to get them centered *exactly*. The most difficult work has now been completed.

The stand is to be made from well-seasoned and thoroughly dried wood; hardwood is preferable. Cut two such pieces as shown in Fig. 3.

The collectors may be made from sheet brass or copper (tin may be used). Heavy copper wire should be soldered to the parts containing the teeth and run to the oscillators; this wire should be heavy, the heavier the better. Nothing smaller than No. 10 gauge should be used and No. 4 is not too large.

Referring to Fig 5, K^1, K^2, K^3 are made of hard rubber or hardwood. The screws pass through the piece K^1 at E^1 and E^2 and fasten the collector to the frame. The hard rubber plates revolve through the teeth shown at S, Fig. 5.

The two neutralizers are to be made next. These should be constructed from brass or copper wire, about No. 14 gauge or larger, and bent as shown at C, Fig. 7. Light brass tinsel can be soldered on the end as shown at X and X^1. If the tinsel cannot be obtained, the small-stranded wires from regular lamp cord may be used. Screws are fastened through the loops shown at C, thus fastening the neutralizers to the standards.

The pulleys are represented in Fig. 4. It is not altogether essential that they are exactly this size, but they should not be changed very greatly.

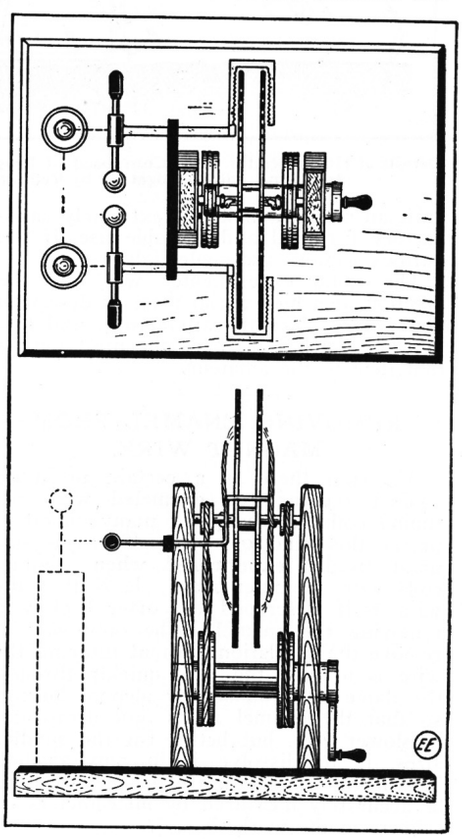
A small crank fits on the end of the shaft at R. This shaft should fit the pulleys tightly. Two belts are required from the larger pulleys to the smaller ones that are mounted on the plates and provided with small grooves to receive the belts. Old sewing machine belts prove very satisfactory.

One belt should be twisted one-half turn so as to reverse the rotation of one plate as compared to the direction of the other.

The plates are held in place and revolved around a ⅛-inch steel or iron shaft extending through the holes bored in the standards shown at Y, Fig. 3.

If the instructions are carefully followed out a very successful static machine will be the result.

The relative position of the neutralizers is best found by experiment. It is, of course, understood that a neutralizer is placed on each side of the machine and not both on the same side, as I knew of one amateur doing.



Top and Side View of a Three Inch Static Machine.

HOW TO DEVELOP X-RAY PHOTOGRAPHS IN FULL DAYLIGHT.

It is rather troublesome when giving a demonstration with Radiographs to resort to the dark room to develop the plates. If prepared according to these directions, the plates can be developed in full daylight. Wrap the dry plates in two thicknesses of red blotting-paper, or, if possible use filter-paper, and expose as usual. Put a mark on the film-side of the wrapped plate so as to place it in the correct position, i.e., film side upwards during exposure.

After the plate has been exposed, pour the developer into a dish and immerse the plate. The developer will soak very quickly through the blotting-paper and act on the film.

The time of development must be determined by several trials, but with Radinal 1:10 about 6 to 8 minutes will be sufficient to develop the plate completely.

After this time the plate, still in its envelope, is transferred to the fixing bath. After it has been in this for about 5 minutes the wrapper may be removed and the plate examined. The negative is then washed and dried as usual. When printing X-ray photographs, print always on glossy gaslight or bromide paper as this stock brings out much more detail than matt paper.

Contributed by C. A. OLDROYD.

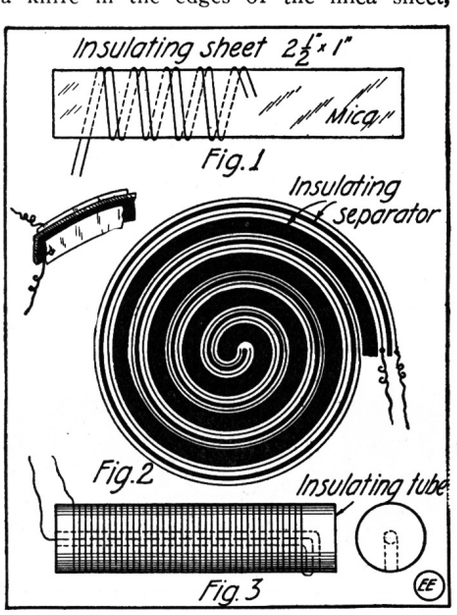
Making Selenium Cells

By Homer Vanderbilt

SEVERAL articles have already been written on the properties of selenium cells, but little practical information has been given on the actual construction of these wonderful light-sensitive cells.

The experimenter who wishes to make the apparatus must first choose a room where the fumes of the molten selenium metal will be driven out, as they are very poisonous. A table near a window is convenient, but no draft should be created, as the temperature of the cell must be kept constant while it is being heated. The next consideration is the use to which the cell will be put. Since this is so essential, several kinds of cells, with their characteristics, will be described. Very little, however, can be said regarding the sensitivity factors. In fact, it is difficult to find or to construct two cells equally sensitive.

One of the simplest forms of selenium cells is the Bidwell type, which consists of a flat, insulated sheet, wrapped with two separate bare wires in a single layer, each of which is insulated from the other, Fig. 1. The insulating sheet consists of a small piece of mica or glass. The former is preferable as it will stand high temperature without being ruptured. The size of the sheet will depend upon the size of the selenium cell, but a piece of mica measuring 2½"x1" is a convenient size. It will be found that such a cell is suitable for practically all sorts of work, such as in the transmission of photographs over a wire, and in television, where large flat cells prove very effective. Two No. 30 B. & S. bare copper wires are wound closely about this mica as shown in the sketch. Extreme care should be taken in keeping the two wires separated from each other and at the same time keeping them very close. If the two wires were widely separated, the resistance of the selenium cell would be very high and thus the sensitivity of the cell would be decreased. A good method of keeping the wires closely spaced and at the same time not short-circuiting them, is to make a number of grooves with a knife in the edges of the mica sheet,



Various Methods of Constructing Selenium Cells, Including the Flat grid, Edgewise Spiral and Cylindrical Forms.

which must be equally spaced and in which the wires are wound. The diagram clearly shows how it should be made. The method of applying the selenium will be described later.

A second type of flat selenium cell is illustrated in Fig. 2, which is also readily built, and consists of two long strips of brass or copper, insulated from each other by a thin sheet of asbestos or mica, then rolled as shown. With such an arrangement a finer selenium cell can be constructed, as the two conducting surfaces are very close to each other, and at the same time are equally distributed throughout. A cell of this type should be constructed with No. 24-gauge brass sheet about 4 feet long by ⅝ inch wide. The asbestos should also be ⅝ inch wide and 1/32 inch thick, the thinner the better. The two strips with the insulation between them should then be rolled up tightly as shown. It is advisable to use a soft grade of sheet brass as it is easier to work with.

This form of selenium cell will be found to be just as good as the first. In fact, it is far more rigid than the other, and for rough use this type is strongly recommended.

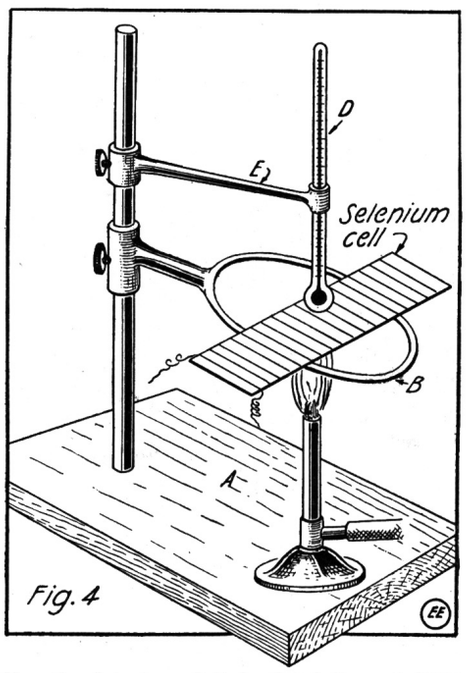
Still another cell of the tubular type is shown in Fig. 3. This form of cell will be found very satisfactory in places where a large active surface cell is required. Experiments on the determination of the intensity of the sun and radiophonic experiments can readily be performed with this type, as for such work a cell having a radial active surface is urgently required.

The wire skeleton is wound on a cylindrical insulating tube, such as glass or porcelain. The latter is advisable, as it is less liable to break when heated. A porcelain tube 3x⅝ inches is the best size, and it can be obtained from any electrical house. On the tube wind two No. 30 B. & S. bare copper wires. The operation should be exactly as for the flat cells, but greater care must be taken in winding the wires, as they are more apt to short circuit than with the other type.

When the skeleton of the cell is made the next and very important operation is the application of the selenium to the wires and to render this material sensitive to light. This last operation is called annealing. The process of annealing is vitally important, as the sensitiveness of the finished cell will depend upon the process.

In order to perform this operation successfully, the following apparatus will be required: A stand A, Fig. 4, having a 6-inch ring B, and a holder E, in which a 200°C. thermometer D, is placed. A standard form of laboratory Bunsen burner must also be obtained. The apparatus should finally be arranged as observed. The next step is to apply the selenium, which must be chemically pure. The selenium must be applied to the skeleton of the cell as follows: Place the form on the ring stand as illustrated in Fig. 4 and heat it with the Bunsen burner until the stick of selenium will melt when brought to the surface. It should not be heated higher than 212°C. Several drops of selenium should be put on the wire grid, and with the aid of a knife blade distributed equally over the complete grid area. Care should be taken to make the selenium surface very thin; in fact, it should be almost, and if possible quite, transparent. Having done this, the unfinished cell is allowed to cool slowly.

We now come to the annealing of the selenium. This may be accomplished by placing it on a strip of mica under which the Bunsen burner is placed. The flame is slowly increased until the surface of the selenium turns a dull gray color. The flame should not be increased after the first signs of melting appear. If melting is observed, the burner must be quickly removed and the flame reduced. The dark gray spots will harden in a few seconds, after which the flame should be reduced and left for two to three hours with the temperature



How the Selenium Cell Is Carefully and Very Slowly Annealed. A Thermometer Is Essential and Can Be Mounted as Shown.

just below, but never above, the melting point of the selenium. The annealing process is then completed by allowing the cell to cool very slowly as the flame is gradually lowered and finally extinguished.

Another method of annealing the selenium is to place the unfinished cell in an oven and heat it for eight to ten hours. After it has been annealed it is cooled quickly.

The process of applying and annealing the selenium is the same for all types of cells so that it is not necessary to explain the details for the other forms.

The resistance of each cell will depend upon the manner in which it is built, so that no definite statement can be made as to what the resistance of the cells will be.

This article should interest the experimenters at this time particularly, since it is so difficult to purchase selenium cells now.

[*Contrary to general opinion selenium in its pure state has an enormously high resistance and can not be used on a cell grid by simply melting it on. It must be crystallized by annealing to render it conductive. The resistance of a stick of C.P. selenium is practically infinite. — Editorial Note.*]

MOVIES CAN BE PRODUCED NOW FROM THE NEWSPAPERS.

Substitution of paper rolls for celluloid films in moving picture machines is made possible by the new "cold" light discovered by a French engineer named Doussaud, which is described to the Academy of Science by Professor Branley, with whom Doussaud studied. The new light is obtained by automatic separation of heat rays from luminous rays.

The light obtained is so intense that images from newspaper illustrations, picture postcards and photographic prints can be thrown on a screen in a lighted room as clearly and sharply as if they were glass lantern slides.

Frequency Meters

By Milton B. Sleeper

THE frequency meter is one of the most puzzling circuit measuring instruments used in a radio or power station. It is rather difficult to understand why a change in frequency or number of complete current reversals per second should cause the indicator to move, or the different reeds to vibrate—depending upon which type of meter is used.

The Westinghouse direct-reading and the Frahm vibrating-reed meters represent the

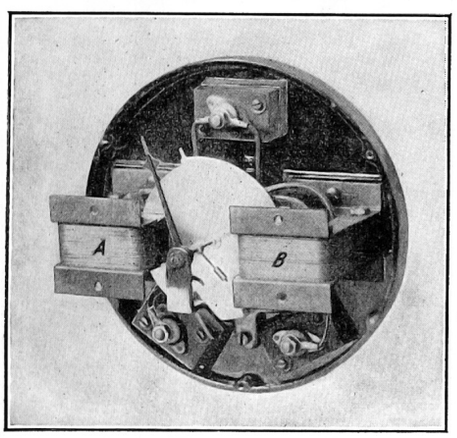


Fig. 1. Commercial Design of Frequency Meter. Direct Reading Type.

principal types of frequency indicators. Fig. 1 shows the front of the Westinghouse type with the scale removed. In this instrument no springs are used; the pointer is controlled by the turning action of two high resistance voltmeter magnets, acting on an aluminum disc which is mounted on the pointer shaft. These magnets are connected to a separate resistor and reactor, Fig. 2. When the current passes through coils A and B eddy currents are set up in the aluminum disc. On the lower poles of the magnets are copper rings. As the magnets are energized, a flux is also set up in the rings, but it is out of phase with the flux of the magnets. This produces a turning torque as the arrows indicate. With a meter on a sixty cycle current, for example, the resultant torques of the magnets are balanced when the pointer is at the center of the scale. A slight increase in the frequency, however, unbalances these forces, for, while the current through the resistor remains the same, the current in the reactor will decrease—owing to the increase in the reactance and total resistance, due to the increase in frequency.

Now the magnet A will exert the greater

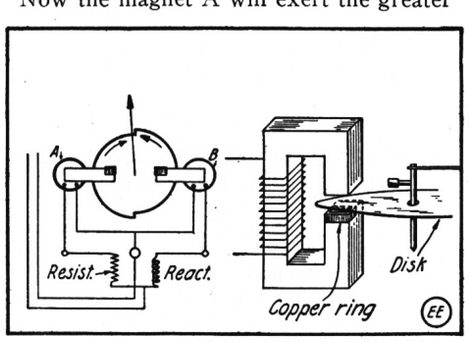


Fig. 2. Connections and Arrangement of Parts in Westinghouse Frequency Meter.

torque. If the disc were perfectly round, it would revolve as in a watt-hour meter. However, the disc is so shaped that as it turns under the influence of magnet A practically the same amount of metal is in the A-gap, but more and more is in the gap of magnet B. Thus the effect of the magnet A is the same, but the effect of magnet B is increased until the forces again balance. *The torque of each magnet is proportional to the square of the current and the frequency.* The left-hand edge of the disc is nearly an arc of a circle having the shaft as its center, but the right hand edge has its center above the shaft. As actually constructed, the edges are *not true arcs,* but have been determined experimentally, to give a uniform scale reading.

This meter is accurate for voltages 25% below and 25% above the normal. Ordinarily it is used on currents of 60 cycles. The greatest advantage in this type of meter is that it indicates directly the fractions of divisions on the scale. It is not, however, as permanently accurate as the vibrating reed type.

The Frahm Meters operate on an entirely different principle. They have no pivoted parts, but use a number of tuned reeds which vibrate in resonance with the current frequency. Fig. 3 gives an idea of the construction. The reeds R, usually 3 mm. wide, made of tempered steel are screwed to a bridge, B. This is attached to the armature, A, of a magnet, M. When the meter is connected across the circuit the current passes through a series resistance, G, and the magnet. At every alternation of the current an impulse is given the armature, and *that reed, which has the same period, vibrates in resonance.* To make the indication plainer, the top of each reed is bent at right angles and painted white. It might seem that this step by step method would not be satisfactory, for the frequency might not be exactly in resonance with the vibrating period of any reed. As a matter of fact, this is not true, as Fig. 4 shows. Here the frequency of the current is exactly sixty cycles, but the reeds on both sides vibrate slightly.

By changing a single switch, an additional coil can be cut in. It has the permanent magnet as a core. Now the changing current causes the magnet to alternately repel and attract the armature, giving one vibration to the reeds for each cycle instead of two. Therefore, the frequency is twice the scale reading. This gives a double range. The usual scale covers a range of 5 to 30 cycles, with intervals of 0.25 to 1.0 between the reeds.

This type of meter is more permanent than others, although it is a little more difficult to read at a distance or when several harmonics are present. They possess, however, the distinct advantage that one or more frequencies may be read on them simultaneously, a condition which often occurs in research work.

For those who have motor generator sets a frequency meter is a necessity if the motor is to be kept running at a constant speed. Those who do not need to use such an instrument should not, at least, become non-plussed when they are questioned regarding them. Moreover, the examinations for operators' licenses usually cover frequency meters

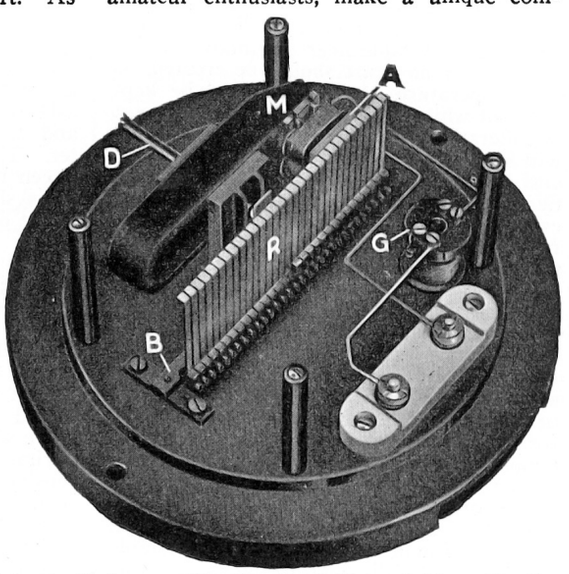


Fig. 3. Frahm or Vibrating Reed Style of Direct Reading Frequency Meter.

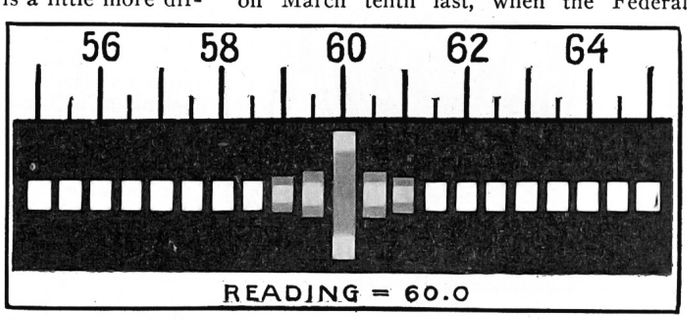


Fig. 4. Appearance of Dial on Vibrating Reed Frequency Meter. The Reeds at Either Side of the "60" Reed Vibrate Slightly as Seen.

THE ADVANCE OF RADIO.

The dominant place of the United States in wireless work is one that the country should be proud of and make every effort to maintain. The Government experts, the commercial companies, and the unattached scientists and inventors who sepcialize in this line, taken together with thousands of amateur enthusiasts, make a unique combination that is capable of accomplishing great results either in war or peace.

That the work on wireless apparatus is not apt to lag from want of enthusiasm is shown by the records of the patent office. More patents are being applied for on improvements in radio devices than in any other field except automobiles and airships. Some of the patents are impracticable, but many are in direct line with recognized needs. Considerable advance has been made in dispatching railway trains by wireless instead of by ordinary telegraph or telephone systems. It is predicted that another five years will see radio dispatching in general use. During the severe blizzard of last January, when telegraph wires were down, the D. L. & W. wireless station at Hoboken, N.J., kept in touch with a number of snow-bound trains.

DAY RADIO RECORD ON PACIFIC BROKEN.

What is considered to be a record on the Pacific for daylight wireless work with vessels at sea from land stations was made on March tenth last, when the Federal Wireless Station at Honolulu picked up the noon position of the American steamer *Sierra,* owned by the Oceanic Steamship Company of that city, 1,620 miles west of Pago Pago, American Samoa, or 3,920 miles from Honolulu.

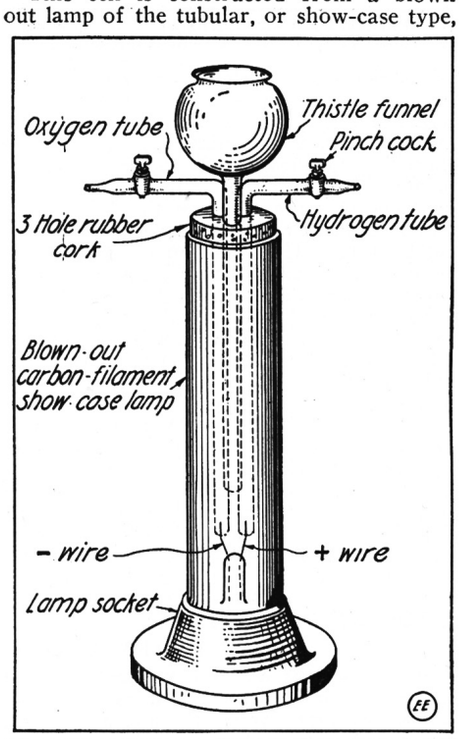
HOW TO MAKE IT

This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

ELECTROLYTIC CELL FOR THE DECOMPOSITION OF WATER.

This cell is constructed from a blown out lamp of the tubular, or show-case type,



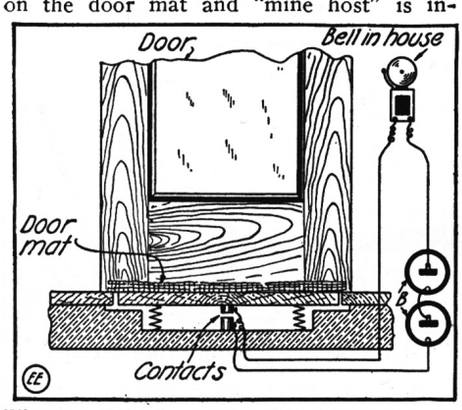
Three Glass Tubes, a Rubber Cork and an Old Incandescent Lamp Make a Capital, Electrolytic Cell

the top of which is cut off and replaced by a rubber cork having three holes in it, through which the glass tubes and funnel are placed as shown. It takes up little room as it may be unscrewed from the socket and put away when not in use.

Contributed by E. T. JONES.

A DOOR MAT SIGNAL FOR VISITORS.

All that one has to do is to wipe his feet on the door mat and "mine host" is informed that someone awaits without. The operation is so simple that even a small poodle dog can let his master know that he would gain entrance by simply coming to the door and stepping on the mat.



When the Hobo Steps Upon This Electric Alarm Mat His Presence is Announced Forthwith to All Present.

A thin board 12"x18" is fastened to the underside of the mat. It is supported on springs which keep it up from the floor beams as shown. Two copper rods are fastened to the bottom of the board and the floor. These should be long enough to touch each other when the board is pressed down. These rods, or a spiral, if it is used in place of the rods, are then to be attached to a battery and bell inside the house. A mat will induce people to step on that certain spot to wipe the dust and dirt from their shoes and so inform their host automatically of their presence.

The mat extends over the edges of the board just far enough to hide the cracks. The movement is so slight as to be unnoticeable.

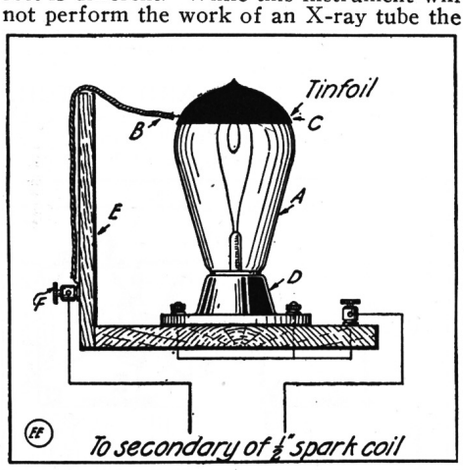
SECOND PRIZE $2.00

USING INCANDESCENT LAMP AS X-RAY TUBE.

First make a base about 5x5 inches, of hard wood. In the center of this base mount an ordinary lamp receptacle. Now put a binding post on one side of the base. Join both connections of the lamp receptacle to this post. Next secure a burned out carbon bulb and place it in the receptacle.

Fasten a small strip of wood E, to the side of the base opposite the binding post. This strip should be the same height as the bulb. Paste (do not use shellac) a small strip of tin foil C, around the end of the bulb. A fine wire is secured to this foil. The end is fastened to the top of the wood strip and brought to the binding post at F. When connected to a spark-coil, this apparatus gives a discharge like an X-ray tube.

The writer has never been successful with a tungsten bulb as the discharge breaks the filament and the glass. Different shapes or sizes of bulbs may be used and the effect is different. While this instrument will not perform the work of an X-ray tube the discharge formed and the principle involved are the same.



Experimental X-Ray Tube Constructed Out of Lamp Bulb. Tinfoil Covers Top of Bulb as Shown.

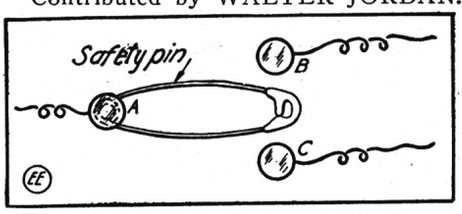
Contributed by VERLIN CONDEE.

THIRD PRIZE $1.00

A "SAFETY-PIN" SWITCH.

Herewith is a sketch of a *safety-pin* switch which I am contributing to the "How-to-Make-It" department. This switch may be quickly constructed from a medium sized safety-pin in emergency and several large thumb tacks serve as points. It can be placed almost anywhere.

Contributed by WALTER JORDAN.



Battery Switch Made From a Safety Pin and a Few Thumb Tacks. What Next? Why Not Use Collar Buttons for Insulators?

This device, which serves the purpose of a push button, is much better because it saves time, extra trouble and is, on the whole, very convenient to all, including the pet poodle dog.

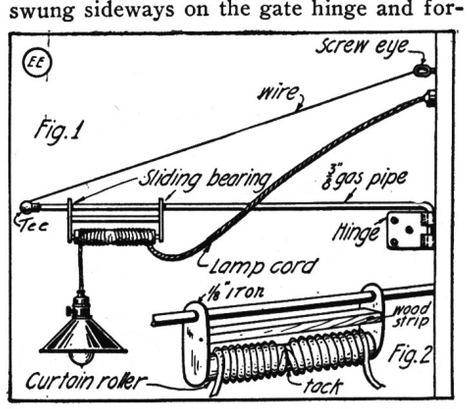
Contributed by JULIUS GREENBERG.

AN ADJUSTABLE SHOP LIGHT.

The materials required for this handy shop lamp are 10 or 12 feet of 3/8-inch gas pipe, threaded at one end to fit a "T" fitting and bent at the other end to fit part of a gate hinge. Also a few feet of guy wire to string from end of pipe to screw eye on wall directly above gate hinge and a few inches of 1/8-inch by 1¼-inch strap iron with which to make the holder for a window curtain roller about 14 inches long. Some lamp cord, a rosette, socket and lamp complete the material list.

The gate hinge is placed about 8 feet above the floor; the screw eye about 4 feet higher.

Any vertical adjustment of this lamp is cared for by the curtain roller. It may be swung sideways on the gate hinge and forward and backward by sliding the curtain roller holder along pipe.

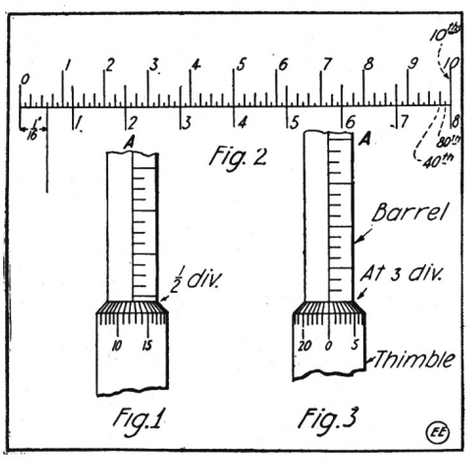


By Using a Shade Roller for the Drum of this Shop Light it May Be Placed at Any Height and Kept There.

Contributed by AN EXPERIMENTER.

SETTING A MICROMETER TO READ SIMPLE FRACTIONS.

By means of a reference-table or the fractional equivalents stamped on the frame.



Simplified Scheme for Reading Fractions on a Micrometer. Every Electrician Will Find This of Extreme Value.

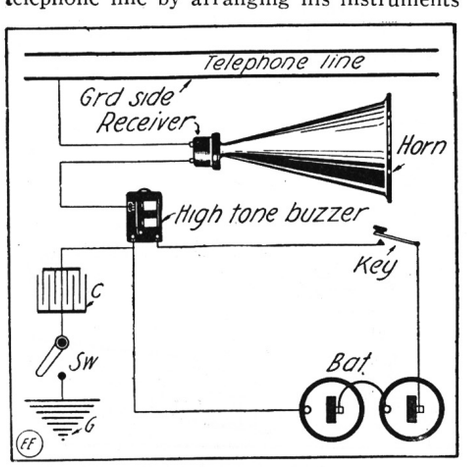
it is easy enough to read fractions from a micrometer, but where a large number of different sized pieces are being calipered, or a rapid method is needed, it requires too much time to refer to the table of equivalents. A simple method of reading eighths is made clear in Fig. 2.

The divisions above the horizontal line represent the marks on the stationary *barrel* of a micrometer. There are ten major divisions, representing tenths of an inch. Each one of these spaces is divided in four parts, equal to one-fortieth of an inch. Now, bearing this in mind, it is easy to read eighths or sixteenths directly. It is plain that five small divisions on the barrel equal one-eighth of an inch, or fifteen spaces equal three-eighths. In making these measurements, the thimble, or rotating scale, must always stop with zero on the A scale. The number of fortieths on the A scale, divided by five, gives the reading in eighths of an inch.

If sixteenths are to be measured, the scale on the thimble will stop at 12.5 on the barrel. Now consider that there are eighty divisions on the barrel instead of only forty. When the thimble is set with 12.5 over the A scale, Fig. 1, the number of eightieths of the A scale, divided by five, gives the reading in sixteenths of an inch.

SIMPLE METHOD OF TELEGRAPHING OVER A TELEPHONE LINE.

Any experimenter may telegraph over the telephone line by arranging his instruments



Method of Rigging up Loud Talker Horn and Buzzer for Telegraphing Over Telephone Circuits.

as shown in the drawing. There will be no need of placing the receiver to the ear.

A friend and I have used this method for some time.

Contributed by HUGH SCHLIESTETT.

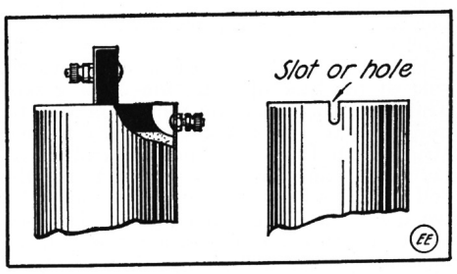
THE AMATEURS' OWN HANDY-BOOK.

Most amateurs possess old catalogues which they usually throw away. Many of these contain valuable information such as wire tables, rules and formulas, call lists and so on. If the pages containing the information are cut out and bound together in some simple manner with stiff cardboard covers they make a really serviceable *Handy-Book*.

Contributed by JOHN B. RAKOSKI.

REPAIRING DRY CELL TERMINALS.

Having broken several negative binding posts off dry cells I hit upon this plan to fix them: Make a small hole the size of the binding post in the zinc where the post was broken off. Dig out the compound around this hole and clean it with a file or sand paper. Obtain a binding post from the carbon of an old battery, and after cleaning it, put



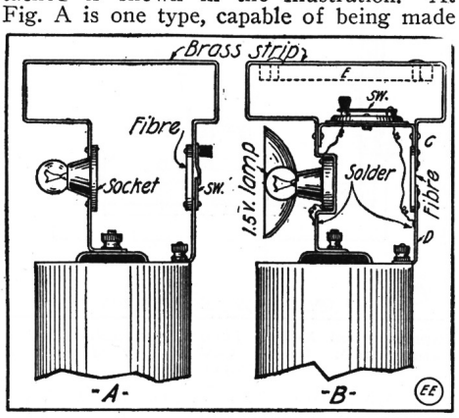
How to Secure Loose Dry Cell "Zinc" Terminals.

it in the hole and tighten the nut. Then fill up the hole in the top of the battery with molten pitch or sealing wax. The end of the screw may have to be cut off a little to make it the proper length.

Contributed by HUBERT CHIDDIX.

DRY CELL LAMP AND SWITCH.

A handy dry cell lamp with switch attached is shown in the illustration. At Fig. A is one type, capable of being made

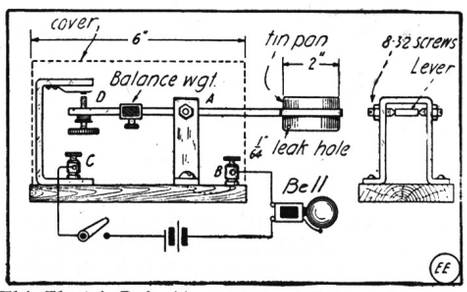


Two Suggestions for Home-Made Dry Cell Flashlights, Incorporating Handle and Switch.

by anyone handy with tools, while at Fig. B is another. The metal strap can be about 1/32-inch by ½-inch or ⅜-inch stock in either case. The former design has the advantage that no wiring has to be used, but the carrying handle is not as strong as the design at B. Here a fibre block has to be inserted between straps, sections C and D, or it may constitute a handle and insulating block combined as at E. A 1.5-volt tungsten lamp is fitted into a porcelain or brass receptacle as perceived in the drawing. The switch arrangement in Fig. B is the more convenient of the two suggested, as the touch of a finger will close or open it without having to remove the hand from the handle.

AN ELECTRIC RAIN ALARM.

This electric rain signal apparatus is fastened on the edge of the window sill with the pan outside. The wires connected to B and C run to the battery and bell as indicated. A strong wind may ring the bell by blowing the pan downward, but if the



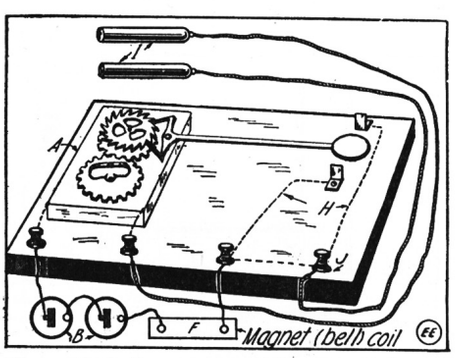
This Electric Rain Alarm Rings Bell When Bucket Fills Up. A Device of Wide Adaptability.

adjustment is correct it will take a very high wind to do this. Of course, the bell will not ring when it first begins to rain, but it will in a few minutes or as soon as there is enough water in the pan to overbalance the lever A. Silver or platinum contacts D serve to close the bell circuit when sufficient rain has accumulated in the catch pan. The instrument should be covered over as shown with a tin hood, through one side of which the lever A projects. A small sliding balance weight is mounted on the lever to admit of accurate adjustment of the outfit. It should be so balanced that a slight over-weight on the pan side will tip the beam A and close the circuit. By a little experimentation it will be found possible to have a small hole (about 1/64 inch dia.) in the bottom of the catch basin, so that when full it can slowly leak out, thus automatically resetting itself for the next rainstorm. The pan may be made removable to facilitate emptying it.

Contributed by SHELDON DAVIS.

SHOCKING MACHINE FROM ALARM CLOCK.

First take the alarm movement A from an old clock and arrange it as shown in the illustration. When the alarm is wound up the hammer moves back and forth between contact points H, thus breaking the circuit. Obtain a piece of board about 6 by 5 inches for the base and fasten the alarm down with screws. Then bend a copper wire around binding post J and back to within 1/16 inch of the hammer. For a pair of handles use two copper or brass tubes I I, about four inches long and two pieces of flexible wire about 18 inches long. Solder one end of each wire to the copper tubes and join the other end to the binding posts, as illustrated. A bell



Alarm Clock Escapement Utilized to Make and Break Shocking Circuit Thru a Coil F.

coil or sounder electro-magnet is connected in series with the battery. This apparatus can be used as a medical coil. A rheostat can be employed if desired. Contributed by VERNON APELGRAIN.

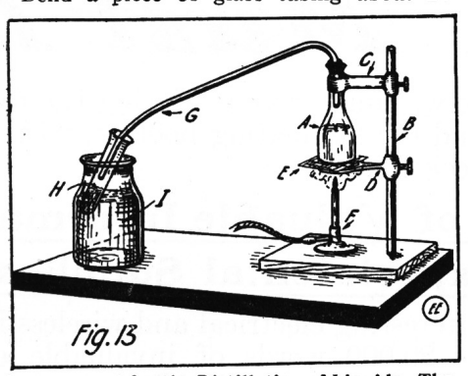
Experimental Chemistry

By Albert W. Wilsdon
Fourth Lesson

DISTILLATION.

TO make the delivery tubes to be used in the following experiments, refer to the June issue of THE ELECTRICAL EXPERIMENTER, under *Bending Glass Tube,* on page 110.

Bend a piece of glass tubing about 24



Arrangement for the Distillation of Liquids. The Vapor Is Condensed in "Cooled" Test Tube at Left.

inches long as shown in Fig. 15 "A" or "B" if it is to be used with a Florence flask; if to be used with a test tube, bend as shown in either "C" or "D."

The glass tubing should be about 24 inches long and each bend about 4 inches. Make true bends, and do not have the tube all kinked up. Fig. 16 "A" shows an incorrect bend which should never be used; "B" shows a properly bent glass tube.

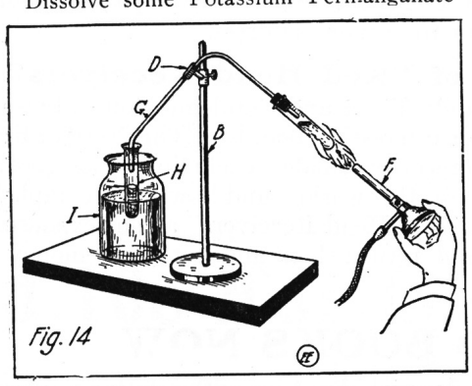
Water may be purified by means of distillation. This consists in boiling the water, as we shall do in Exp. No. 10, and then condensing the vapor in a cold receiver, standing in cold water or ice.

The principle of distillation lies in the fact, that at 100° Centigrade, or 212° Fahrenheit, water is converted into steam. Mineral matter, such as magnesium, iron, and so forth, which are the chief ingredients found in impure water, will be found to vaporize at a higher temperature than that of water, namely, 100° C. or 212° Fahr.; therefore the steam, when passed into a cold tube, condenses to form water, which is practically pure. Distilled water is not, however, absolutely pure, as there are traces of mineral matter (as well as gases which are absorbed from the air) contained in it.

Distillation is sometimes used on board ships, to convert salt water, which is taken from the ocean, into fresh water, which is pure enough for drinking and cooking.

EXPERIMENT NO. 10—

Dissolve some Potassium Permanganate

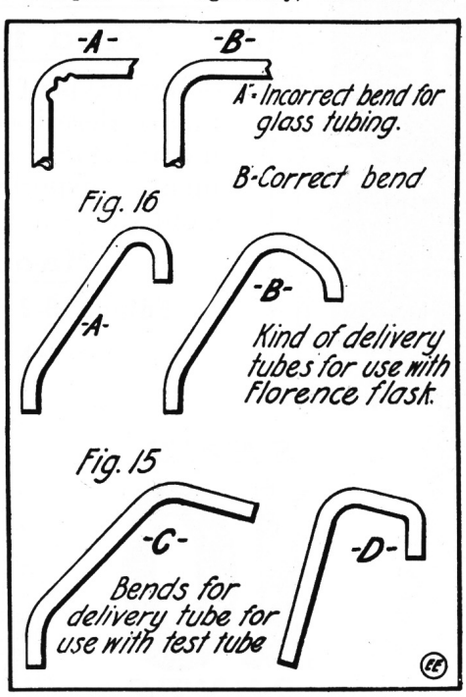


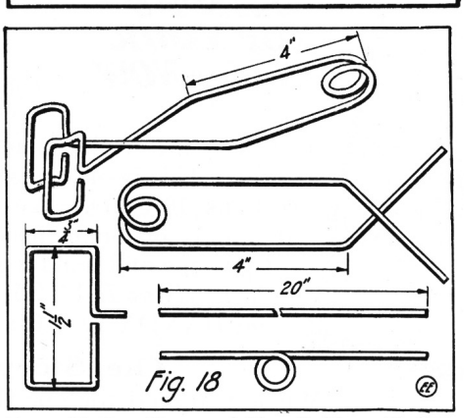
Method of Distillation by Means of Test Tube in Flame in Place of a "Florence" Flask.

in about 150 c.c. of water, which will produce a deep violet liquid, and put into a Florence flask of about 250 c.c. capacity, as shown in Fig. 13. If a test tube is employed to hold the liquid, use a large one, about 7 x 1 inch, and fill half full of water. Then dissolve the potassium permanganate in it.

In place of potassium permanganate copper sulphate or red ink, may be used; in fact anything which will color the water which is to be distilled in the test tube, so that the *distillate* and the *original liquid* may be compared.

Place the flask on a piece of wire gauze on the large support of a ring stand, and set up the balance of the apparatus as shown in Fig. 13. Next apply the heat of a Bunsen burner, being careful not to boil the liquid too rapidly. If you should boil the liquid too vigorously, remove the





Above: Various Shapes of Glass Tubing with Correct and Incorrect Bends. Below: Simple Test Tube Holder Made of Heavy Wire, Bent as Shown.

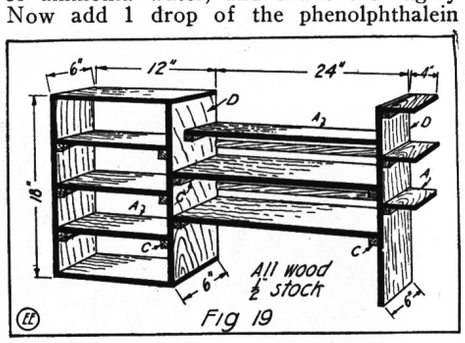
burner, and, if any of the liquid in the flask should pass over the delivery tube, into the test tube, throw away the water in the test tube, and commence over again, after cleaning the entire apparatus. Continue the boiling until you have collected about 20 c.c. of the condensed steam (the distillate) in the test tube H.

EXPERIMENT NO. 11—

Pour about 5 or 10 c.c. of the distillate (the water you collected in test tube H in Exp. 10) in two clean test tubes.

In one of these tubes allow a drop of phenolphthalein solution to mix with the pure water. You will notice that a clouded white solution has formed.

Into the other test tube put 1 drop of either ammonium hydroxide (NH_4OH) or ammonia water, and shake thoroughly Now add 1 drop of the phenolphthalein



Useful Glass-ware and Chemical Rack, for Mounting at Back of Work Table.

solution to this mixture. Record your results.

Upon adding the phenolphthalein solution to the water containing the ammonia, a light cherry-red solution should be formed. This is a very delicate test for the presence of ammonia in water.

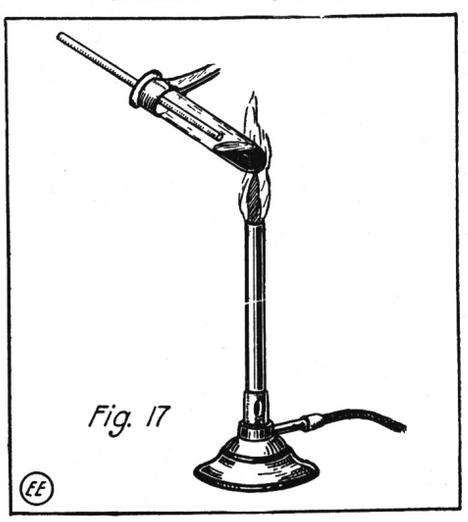
SUBLIMATION.

EXPERIMENT NO. 12—

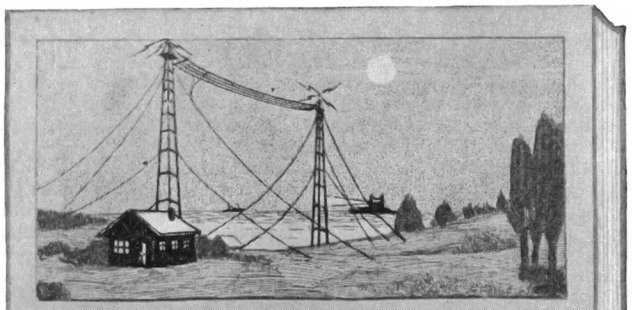
Put 3 or 4 crystals of iodine into a wide, perfectly dry test tube. Have a dry stirring rod in the right hand, and with the left hand hold the tube containing the iodine in the flame of a Bunsen burner. As soon as dense purple fumes begin to rise in the tube, remove the tube from the flame and thrust the stirring rod into the tube, see Fig. 17, nearly to the bottom, being careful not to touch the sides of the tube with the rod. Keep it there until the iodine vapor is settled, and examine both tube and rod by means of a lens.

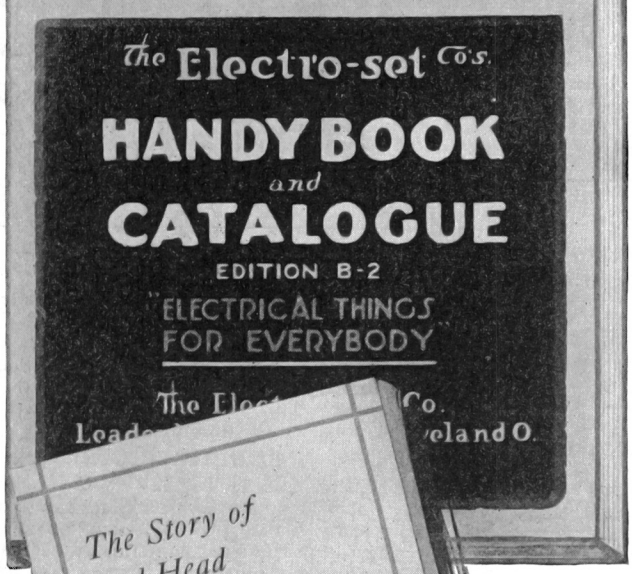
It will be noticed that when the rod was thrust into the dense violet vapor, this vapor *disappeared* after a short time, and when the rod was withdrawn, a finely powdered coating appeared on the lower part, which was not there before being lowered into the tube. It will also be noticed that a finely powdered coating has formed in the tube about one inch from the bottom. To sum this change up, we started with a large crystal, and, by applying heat to this

(Continued on page 377)



Experiment in "Sublimation" of Iodine. Similar to Action Occurring in "Distillation."





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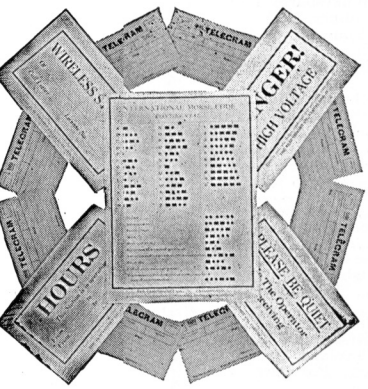

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Waterville, Me.
Gentlemen: The last two pieces of Galena I bought of you were the best I ever saw.
160 College Ave. HAROLD M. CLAFLIN.

Vandergrift, Pa.
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OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1916. (Continued.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
	SIXTH DISTRICT.		
6HO	Ardenyi, Wm. A.	41 Greenbank Ave., Piedmont, Cal.	.5
6OV	Atkins, Carl	145 N. Hancock St., Los Angeles, Cal.	1
6RB	Barbagelata, Russell	604 42d St., Oakland, Cal.	..
6EE	Billhimer, Samuel J.	Colfax, Cal.	.5
6GR	Brown, Clarence C.	1038 Balboa St., San Francisco, Cal.	.5
6FM	Carroll, Russell W.	354 Perry St., Oakland, Cal.	.5
6HE	Castro, Morris	232 Lexington Ave., Rust, Cal.	.5
6KM	Dalby, Wm.	2907 Hillegass Ave., Berkeley, Cal.	1
6LK	Diamond, Ray	Piedmont Park, Oakland, Cal.	1
6TB	Dietz, Irwin C.	136 S. Griffin Ave., Los Angeles, Cal.	.5
6NK	Duncan, Harold	131 W. Jefferson St., Los Angeles, Cal.	.5
6TH	Fabian, Ernest	1368 20th Ave., San Francisco, Cal.	.5
6PE	Fleming, Robert P.	606 San Benito St., Los Angeles, Cal.	.5
6OD	Foster, Lewis K.	3452 16th St., San Francisco, Cal.	.5
6RM	Gabriel, Edward J.	657 Guerrero St., San Francisco, Cal.	.5
6NC	Gould, William S.	560 D St., San Rafael, Cal.	.5
6AI	Green, Alfred	221 E. Anderson St., Stockton, Cal.	.5
6ME	Gregory, Marshall	554 5th St., San Diego, Cal.	.5
6SL	Hart, Cedric E.	718 6th Ave., Salt Lake City, Utah.	1
6UI	Helmer, Glenn	343 N. Comstock Ave., Whittier, Cal.	.5
6CI	Hillen, Russell W.	162 W. Alvarado St., Pomona, Cal.	.5
6HB	Hunt, Homer G.	1740 96th Ave., Oakland, Cal.	1
6FC	Isham, Carlton	1323 96th Ave., Oakland, Cal.	.5
6KF	Jackson, Milton S.	833 17th St., San Diego, Cal.	.5
6GS	Johnson, Philip	475 California St., Pasadena, Cal.	.5
6GV	Jones, Alfred H.	962 D Ave., Coronado, Cal.	.5
6KI	Jones, Ernest P.	R. F. D., Auburn, Cal.	.5
6GX	Long, Herman D.	402 N. New 18th St., San Jose, Cal.	.5
6SJ	Lopez, John	1645 S. New Hampshire St., Los Angeles, Cal.	.5
6SE	Lynde, Laurence F.	Huntington Drive, Los Angeles, Cal.	.5
6MS	McArdle, James J.	263 Day St., San Francisco, Cal.	.5
6EZ	McHolland, Raymond	2800 Oregon St., Los Angeles, Cal.	1
6SH	Macquarrie, Harold C.	405 E. Fremont St., Stockton, Cal.	1
6GG	Malarin, Henry J.	719 Page St., San Francisco, Cal.	.5
6WD	Martinelli, Ennis	953 Mission Ave., San Rafael, Cal.	.5
6JE	Mead, John H.	7231 Hollywood Blvd., Los Angeles, Cal.	.5
6JW	Meyer, Joseph U.	804 40th St., Oakland, Cal.	.5
6EU	Michelson, Melvin O.	530 Franklin St., Napa, Cal.	.5
6WB	Moller, Wm., Jr.	426 29th St., Oakland, Cal.	.5
6MA	Montgomery, Alvin R.	2303 Pacific Ave., Alameda, Cal.	1
6IW	Muller, Lloyd	832 Haight St., San Francisco, Cal.	.5
6PB	Pagh, Val E.	Randsburg, Cal.	.5
6MP	Parsons, Wm.	2921 Manitou Ave., Los Angeles, Cal.	.5
6WI	Powell, Joseph F.	1125 N. Wilson Ave., Pasadena, Cal.	1
6CH	Raley, Mannie L.	Lordsburg, Cal.	.5
6SP	Rathbun, Theodore B.	1202 S. Normandie Ave., Los Angeles, Cal.	.5
6GJ	Richardson, Charles E., Jr.	406 W. 28th St., Los Angeles, Cal.	1
6GB	Roberts, Edwin D.	Los Altos, Cal.	.5
6FB	Rutherford, Paul H.	431 San Francisco Ave., Pomona, Cal.	1
6NL	Sawyer, Clifford D.	47 Washington St., Reno, Nev.	.5
6IO	Shaffer, John	846 E. 33d St., Los Angeles, Cal.	.5
6AZ	Springman, Arthur E.	1818 N. Broadway, Los Angeles, Cal.	1
6DD	Stagi, Guadenzio	Los Altos, Cal.	.5
6RH	Stamback, Rollo L.	753 Redondo Ave., Long Beach, Cal.	.5
6RP	Stonecipher, Charles E.	7227 S. Moneta Ave., Los Angeles, Cal.	.5
6HP	Stonehocker, Harold	1732 Webster Ave., Fresno, Cal.	.5
6SG	Themer, Francis	1536 F St., San Diego, Cal.	.5
6NE	Thompson, Lloyd	239 E. Whiting Ave., Fullerton, Cal.	1
6HT	Walters, Wm. T.	2140 Tyler Ave., Fresno, Cal.	.5
6KW	Warriner, Willard V.	245 Eagle Rock Ave., Los Angeles, Cal.	1
6EY	Watson, Edwin A.	1611 Walnut St., Alameda, Cal.	.5
6FE	Wickersham, Harry H.	149 San Carlos Ave., San Francisco, Cal.	.5
6NB	Winter, Gilbert H.	1742 Bushnell Pl., Berkeley, Cal.	.5
6RT	Wright, Harry E.	935 Harrison St., Oakland, Cal.	.5
	SEVENTH DISTRICT.		
7HE	Carroll, Thomas M.	1913 E. Alder St., Seattle, Wash.	.5
7WC	Cates, Walter C.	1704 Franklin St., Vancouver Wash.	1
7DQ	Drinker, Russell	1003 Lynn Ave., Portland, Oreg.	.5
7FI	Fraser, James E.	1105 West A St., North Yakima, Wash.	.5
7EE	Hawkins, Edward K.	1800 27th Ave., South, Seattle, Wash.	.5
7JH	Hurtt, John N.	1067 E. Burnside St., Portland, Oreg.	.5
7MJ	Mead, Walter J.	Nehalem, Oreg.	1
7SN	Norman, Stacy W.	137 79th St., Seattle, Wash.	.5
7PO	Poole, Orell A.	Wallowa, Oreg.	.5
7GQ	Reeder, Ardis H.	412 South K St., Tacoma, Wash.	.5
7RF	Ryberg, Roy E.	525 Federal Ave., Seattle, Wash.	.5
7DH	Tennican, Leonard S.	4016 Colby Ave., Everett, Wash.	1
7FP	Trumbull, Wm. L.	365 McGrew St., Seattle, Wash.	1
7LF	White, Lester T.	1090 Water St., Portland, Oreg.	.5
7JW	Wilson, John C.	295 N. 24th St., Portland, Oreg.	1
	EIGHTH DISTRICT.		
8AOR	Adams, Joy C.	48 N. Wabash Ave., Battle Creek, Mich.	1
8TX	Anders, Harry R.	Decatur, Mich.	.5
8AAB	Anderson, L. R.	Youngstown, Ohio.	.5
8APM	Auten, George C.	Oberlin, O.	1
8APK	Bachtel, Alfred	Akron, O.	.5

Call signal	Owner of station.	Location of station.	Power kilowatts.
	EIGHTH DISTRICT—(Cont'd.)		
8AAW	Baer, Walter D.	350 Graham St., Pittsburgh, Pa.	1
8FW	Banes, Charles C. A.	143 Chess St., Monongahela City, Pa.	.5
8APA	Beer, Frank P.	514 Jarvella St., Pittsburgh, Pa.	1
8AAO	Bishman, Richard F.	67 Foster Ave., Norwalk, O.	.5
8APN	Bock, Ashley P.	1112 W. North St., Kalamazoo, Mich.	1
8AAS	Bower, Geo. C.	Blasdell, N. Y.	.5
8AOP	Bowyer, Glenn B.	Kinsman, O.	.5
8AOK	Brewster, Fred J.	6904 Cedar Ave., Cleveland, O.	.5
8FR	Briggs, Fred G.	221 Forest St., Marion, O.	.5
8ADP	Brown, Clarence W.	R. F. D. No. 25, Akron, O.	.5
8WZ	Brown, Ralph M.	156 W. River St., Wilkesbarre, Pa.	1
8ABA	Burgwardt, Fred. C., Jr.	R. F. D. No. 2, Hamburg, N. Y.	.5
8TA	Burson, John I.	238 W. Wood St., Youngstown, O.	.5
8WR	Carter, David G.	Grosse Pointe, Mich.	.5
8PW	Case, Theodore J.	1609 S. University Ave., Ann Arbor, Mich.	.5
8API	Childs, Herbert R.	12 Bengel Ter., Rochester, N. Y.	.5
8AOH	Clauve, Carl H.	435 Shillito St., Cincinnati, O.	.5
8AOW	Clem, Robert	605 N. Jameson St. Lima, O.	.5
8SL	Cocklin, Gilbert W.	Middlebranch, O.	.5
8ABS	Colville, Perkins	514 E. Buffalo St., Ithaca, N. Y.	1
8AOX	Cooley, Clair R.	298 Walbridge Ave., Toledo, O.	.5
8WV	Corts, Ray E.	243 May St., Buffalo, N. Y.	.5
8AOV	Cramer, Charles F.	115 N. Fountain St., Springfield, O.	1
8AOG	Creps, John A.	1431 Lakewood Ave. Lima, O.	.5
8ADI	Cundall, Lincoln A.	Hamburg, N. Y.	.5
8AOI	Curtiss, Gerald H.	624 9th St., Traverse City, Mich.	1
8AAQ	Devinney, Robert C.	1224 Boyle St., Pittsburgh, Pa.	1
8AOT	Demarest, Foster J.	103 Washington St., Williamsport, Pa.	1
8AOA	Dieter, Howard L.	253 S. 18th St., Columbus, O.	1
8AQD	Dilworth, John G.	6121 Jackson St., Pittsburgh, Pa.	.5
8AOJ	Durstine, John E.	107 Burton Ave., Cleveland, O.	.5
8AOS	Eiszler, Emmerson L.	1227 California Ave., Pittsburgh, Pa.	.5
8AOZ	Ferris, James H.	211 Catalpa Drive, Royal Oak, Mich	1
8FV	Francis, Jesse J.	1556 E. 66th St., Cleveland, O.	.5
8AAV	Frank, Newton J.	411 Humboldt Pky, Buffalo, N. Y.	.5
8ABE	Gottschalt, Robert	102 Burton Ave., Cleveland, O.	1
8WA	Griffin, Jesse W.	Middlefield, O.	.5
8AOM	Hamel, Arthur	29 Martin Ave., Amherst, O.	1
8AMI	Hanny, George	1716 Buena Vista St., Pittsburgh, Pa.	.5
8AA	Hausdign, Wm. A.	Traverse City, Mich.	.5
8APG	Henes, Christian	604 Main St., Hamilton, O.	1
8AMP	Hodgkins, Harley G.	Massena, N. Y.	.5
8GT	Hoover, Raymond	Maumee, O.	.5
8ABR	Howe, Richard H.	Granville, O.	.5
8FL	Hudson, Albert N.	406 Park Ave., Fulton, N. Y.	.5
8APR	Huff, Samuel W.	915 Campbell St., Williamsport, Pa.	.5
8AOY	Hughes, Edwin R.	20 74th St., Carthage, O.	.5
8AOE	Hull, James E.	329 Main St., Cheboygan, Mich.	1
8NK	Hunt, Barton L.	1280 Courtland Ave., Columbus, O.	.5
8ABN	Jones, Hugo W.	109 Marshall St., Conneaut, O.	.5
8WF	Judd, Max A.	Chesaning, Mich.	.5
8AOC	Kent, Arthur L.	199 Court St., Binghamton, N. Y.	.5
8AQE	Kerstetter, J. Howard	633 Carlton St., Toledo, O.	.5
8AQA	King, Wm. R.	6920 Wellesley Ave., Pittsburgh, Pa.	1
8QF	Kirchner, Charles	425 Cumberland Ave., Buffalo, N. Y.	.5
8ADJ	Kohli, Homer J.	Pandora, O.	1
8MM	Levy, Irving R.	1333 E. Blvd., Cleveland, O.	1
8RH	Locke, Carl M.	1500 Coutant St., Lakewood, O.	1
8APE	Lockwood, Harry P.	312 Huron St., South Haven, Mich.	.5
8IK	McDowell, M. Fay	612 Mithoff St., Columbus, O.	1
8AOU	McKee, Robert R.	7008 Church Ave., Ben Avon, Pa.	1
8LM	MacLaughlin, Donald	261 W. 8th St., Marysville, O.	1
8AKJ	Merrick, W. Bernard	156 Marshall St., Conneaut, O.	.5
8UL	Mitchell, Phillip	8806 Blaine Ave., Cleveland, O.	.5
8UZ	Moore, John B.	141 Park St., Buffalo, N. Y.	.5
8AOF	Morrow, Lorentz A.	1231 E. High St., Springfield, O.	1
8SR	Mueller, Henry C.	1919 Doll St., Plttsburgh, Pa.	.5
8AAM	Murdoch, Wm. B., Jr.	301 W. College St., Canonsburg, Pa.	.5
8ANZ	Murray, Charles J.	701 W. Fair St., New Philadelphia, O.	.5
8EN	Myers, George E.	R. F. D. No. 1, Grand Blanc, Mich.	.5
8APT	Newton, Harold D.	565 School St., South Haven, Mich.	.5
8ADQ	Olson, Elvin E.	Frankfort, Mich.	.5
8AMK	Perry. Paul A.	136 Woodbine Ave., Rochester, N. Y.	.5
8CJ	Plantinga, John G.	10321 Ashbury Ave., Cleveland, O.	1
8RU	Poad, Edwin H.	1509 E. 123d St., Cleveland, O.	.5
8AOD	Ragsdale, Charles C. C.	146 S. Bryant Ave., Bellevue, Pa.	1
8LS	Rawson, Myron A.	535 Lodi St., Elyria, O.	.5
8APW	Reichle, Henry W.	Morrison and Cleveland Aves., Pittsburgh, Pa.	.5
8APG	Richardson, Norton	70 Davenport St., Detroit, Mich.	.5
8AOO	Sauerbrey, Wm. J.	Shenandoah, Pa.	.5
8AOQ	Saunders, Ezra L.	141 4th Ave., Gallipolis, O.	1
8APD	Schmidt, Paul	106 Excelsior St., Pittsburgh, Pa.	.5
8APU	Servais, Francis W.	Falls Creek, Pa.	1
8TE	Shafer, Andrew L.	Scott, O.	.5
8KZ	Snyder, Lawrence L.	260 S. Walnut St., Ravenna, O.	1
8ABK	Storck, Howard J. C.	694 Carpenter St., Columbus, O.	.5
8TO	Stotter, Herbert J.	1397 E. Blvd., Cleveland, O.	1
8AK	Taylor, Willard L.	148 Kennedy St., Syracuse, N. Y.	1
8SZ	Tobin, W. A.	426 W. McKibben St., Lima, O.	1
8APO	Twitchell, H.	4th and Wood Sts., Hamilton, O.	1
8QT	Van Buren, Harold J.	114 N. Crawford Ave., New Castle, Pa.	1
8OB	Wachs, Wm. C.	235 Hosea Ave., Cincinnati, O.	.5
8EJ	Watson, Samuel C.	Wilberforce, O.	1
8EY	Weaver, J. Marshall	208 N. Main St., Greensburg, Pa.	.5
8JJ	Weber, Walter B.	660 Riley St., Buffalo, N. Y.	1
8TM	Do.	791 Seneca St., Buffalo, N. Y. (has 2 stations)	1

(*Continued on opposite page*)

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1916 (Continued).

Call signal	Owner of station.	Location of station.	Power kilowatts.
	EIGHTH DISTRICT—(Cont'd.)		
8TF	Welch, Thomas E.	92 N. Main St., Mechanicsville, N. Y.	1
8APS	Welty, Noble K.	302 W. College St., Canonsburg, Pa.	.5
8ACS	Wiley, Donald A.	3029 Harvey Ave., Cincinnati, O.	.5
8VK	Willard, Charles A.	2025 W. 95th St., Cleveland, O.	.5
8KT	Williamson, Warren, Jr.	1840 Market St., Youngstown, O.	.5
8GC	Wilson, Albert S.	Apollo, Pa.	1
8AOL	Wood, Walter S.	752 Ardmore St., Akron, O.	.5
8AON	Worden, Ralph P.	665 Lafayette Rd., Medina, O.	.5
8AI	Wright, Wm. A. S.	7216 McCurdy Pl., Ben Avon, Pa.	.5
8VV	Zeigler, Harry W.	7th and Ross Sts., Tarentum, Pa.	1
	NINTH DISTRICT		
9DI	Ahrensfeld, Wm. H.	200 N. Prospect Ave., Park Ridge, Ill.	.5
9ACI	Allen, George M.	435 Lane St., Topeka, Kans.	.5
9HZ	Anderson, Ivan H.	1711 11th Ave., South Minneapolis, Minn.	.5
9MP	Anderson, Paul D.	Lamoni, Iowa.	1
9ABR	Baker, Warren C.	38 E. Madison St., Tipton, Ind.	1
9EM	Ball, George W.	6601 Olmsted Ave., Chicago, Ill.	1
9EJ	Barnett, Lawrence T.	684 Greenleaf Ave., Glencoe, Ill.	.5
9ADL	Bates, Clarence	2015 Wells St., Milwaukee, Wis.	1
9AAU	Blasier, Herbert, Jr.	Williamsburg, Iowa.	1
9CP	Brauch, Nicholas	515 Court St., Le Mars, Iowa.	1
9LD	Brooks, Ralph	27 156th Pl., West Hammond, Ill.	1
9ADO	Bullock, Merlin and Gerald	3600 Gladstone Blvd., Kansas City, Mo.	1
9ABE	Button, Bert A.	2850 R St., Lincoln, Neb.	1
9ADH	Clark, Donald L.	3240 Alcott St., Denver, Colo.	.5
9ABD	Corwin, Willis	117 E. McCarty St., Jefferson City, Mo.	.5
9NF	Cottrell, Wm. R.	Prairie City, Iowa.	1
9ABA	Crabb, Thomas G.	5906 Cater Ave., St. Louis, Mo.	1
9ACN	Curry, Wilfred N.	Sweet Springs, Mo.	.5
9KZ	Davis, Wm. R.	1409 W. Edwards St., Springfield, Ill.	.5
9ACT	Degner, Le Roy	394 24th Ave., Milwaukee, Wis.	1
9DX	Deich, Dayton, P.	Limon, Colo.	.5
9ABN	Deming, Herschel	1545 Barth Ave., Indianapolis, Ind.	.5
9ACA	Doerfler, Hilary	Collegeville, Minn.	.5
9ACG	Duncan, Wilbur H.	1199 W. Wood St., Decatur, Ill.	.5
9BA	Elmore, Virtus R.	615 N. Madison St., Marion, Ill.	1
9ADC	Erickson, Einer A.	225 Lafayette Ave., Racine, Wis.	.5
9ABT	Fedder, Herman	1440 W. High St., Davenport, Iowa.	.5
9ACR	Frank, George	1727 W. 2d St., Davenport, Iowa.	.5
9ADA	Franklin, Maurice W.	Seward, Neb.	1
9EU	Frech, Lester	336 E. Sutterfield St., Fort Wayne, Ind.	.5
9ABS	Frenzel, Oscar F., Jr.	1338 N. New Jersey St., Indianapolis, Ind.	.5
9MK	Giddings, Edward H.	Lanark, Ill.	.5
9JN	Glasgow, Roy S.	3966 Arsenal St., St. Louis, Mo.	1
9ACS	Gooch, Bertram	703 Marion St., Boone, Iowa.	1
9KF	Goorisich, John A.	2316 Clybourn St., Chicago, Ill.	.5
9LY	Greene, Clark W.	1113 Park Row, Lake Geneva, Wis.	.5
9ACD	Greene, John	Prairie du Chien, Wis.	.5
9ADB	Greenwood, George W., Jr.	1321 Western Ave., Topeka, Kans.	.5
9DF	Hagedorn, Gilbert H.	357 N. Pleasant St., Kenosha, Wis.	.5
9ACU	Hageman, Edwin S.	Ellsworth, Wis.	.5
9AAY	Harris, Frank M., Jr.	920 N. Harrison St., Topeka, Kans.	.5
9ADQ	Hecht, Royal H.	1523 Estes Ave., Chicago, Ill.	1
9CR	Heise, Paul A.	841 Wilson Ave., Chicago, Ill.	1
9IL	Hellwig, Emil C.	1729 Sunnyside Ave., Burlington, Iowa.	.5
9ABI	Honecker, Walter	3106 Graceland Ave., Indianapolis, Ind.	.5
9MO	Huffman, Verne A.	218 Jackson St., Polo, Ill.	.5
9ADG	Hughes, Arthur S.	7390 Maple Ave., Maplewood, Mo.	1
9ADF	Jarboe, Owen	109 Locust St., Carrollton, Ill.	1
9ACM	Jeffrey, Albert E.	High School, Goshe, Ind.	1
9ADE	Keller, Carl E.	Kinsey, Kans.	.5
9AAT	Kenyon, Vernon N.	Dunwoody School, Minneapolis, Minn.	1
9ABM	Kingsland, Le Roy	2326 Clarence Ave., St. Louis, Mo.	.5
9ADM	Le Vine, George L.	801 W. 7th St., Des Moines, Iowa.	1
9AX	Loosen, Irving R.	2609 Olive St., Kansas City, Mo.	1
9ADK	MacMillan, Charles W.	635 Vine St., Denver, Colo.	.5
9ACK	McQuilkin, Joseph R.	1815 N. 6th St., Sheboygan, Wis.	.5
9AG	Martens, Hugo	2015 Gaines St., Davenport, Iowa.	.5
9AAZ	Mathiasen, Carl A.	Onawa, Iowa.	.5
9MN	Maynard, P. Neff	208 W. 7th St., Boone, Iowa.	1
9KG	Melcher, John M.	Wautoms, Wis.	.5
9ADD	Meldru, George E.	Carrollton, Ill.	.5
9KR	Miller, John F.	670 Rush St., Chicago, Ill.	1
9FH	Millspaugh, Charles H., Jr.	317 S. Franklin St., Decatur, Ill.	.5
9AAV	Mole, Harry H.	2853 Fowler Ave., Omaha, Neb.	.5
9EE	Mueller, Clarence	2421 N. Sawyer Ave., Chicago, Ill.	.5
9ABU	Myers, Wilford U.	209 N. 3d St., Charleston, Mo.	.5
9ADJ	Nelson, Lee M.	Seward, Neb.	1
9MG	Novak, Joe J.	4031 S. Campbell Ave., Chicago, Ill.	.5
9AF	O'Connell, John B.	6218 Ellis Ave., Chicago, Ill.	.5
9FB	Pearce, Wm. W., Jr.	538 Steele Court, Waukegan, Ill.	.5
9KI	Petersen, Howard E.	1424 E. 70th St., Chicago, Ill.	1
9NU	Perry, William N.	825 Lake Ave., Racine, Wis.	.5
9ABW	Pfeiler, Lawrence	1810 N. 5th St., Sheboygan, Wis.	1
9ACW	Pfister, Walter	516 Erie Ave., Sheboygan, Wis.	.5
9GT	Pollard, Lynn	929 W. Governor St., Springfield, Ill.	.5
9KD	Rathert, Will P.	316 W. 5th Ave., Cresco, Iowa.	1
9ADI	Rufsvold, Arnold S.	3216 16th Ave., South, Minneapolis Minn.	.5
9FI	Salisbury, Hubbard H.	1703 Hanks Ave., Superior, Wis.	.5
9FC	Schulte, Herman	Oregon, Mo.	1
9AAX	Schulze, A. N.	2864 Amos Ave., Omaha, Neb.	.5
9BY	Scoven, Paul	327 E. Park Ave., Kokomo, Ind.	.5
9ACE	Shanks, Charles E.	2660 Sutton Ave., Maplewood, Mo.	1
9ABO	Shephard, Floyd P.	936 Center St., Racine, Wis.	.5
9EY	Simms, Lincoln J.	318 Locust St., Elgin, Ill.	1
9ABG	Smith, Noble	1329 Brook St., Louisville, Ky.	.5
9JK	Snyder, Wm. O.	Sweet Springs, Mo.	.5
9LJ	Spencer, Alvin C.	Magnolia, Ill.	1
9KP	Spencer, Levi	Gilman, Ill.	.5
9ADP	Stanley, Charles A.	1415 N. Hillside Ave., Wichita, Kans.	1
9AM	Theisen, Peter J.	3413 Meade St., Denver, Colo.	.5
9AAW	Todd, J. Richard	Louisville, Ill.	.5
9ABK	Todd, Leonard	2269-A Red Bud Ave., St. Louis, Mo.	.5
9BK	Trier, Paul W.	803 2d Ave. Maywood, Ill.	.5
9EF	Vander Veer, Guy E.	1246 W. Randolph St., Chicago, Ill.	.5
9FA	Walker, Lloyd A.	1716 S. 20th St., St. Joseph, Mo.	.5
9AY	Ward, Lloyd S.	1227 Chestnut St., Rockford, Ill.	1
9ACO	Wittick, Eugene C.	104 6th Ave., Moline, Ill.	.5
9ADN	Wright, Kenneth E.	855 Grand Ave., Waukegan, Ill.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of March, 1916.

Call signal	Owner of station.	Location of station.	Power kilowatts.
	FIRST DISTRICT		
1EMI	Baker, J. Stannard.	40 Sunset Ave., Amherst, Mass.	.5
1EMA	Bauer, Paul S.	169 Lynn Shore Drive, Lynn, Mass.	1
1EAH	Berry, Gerald D.	28 N. Central Ave., Wollaston, Mass.	.5
1KE	Blackie, Norman E.	110 Norfolk St., Dorchester, Mass.	.5
1EAK	Blake, Wm. F.	104 Rutherford Ave., Charlestown, Mass.	.5
1EMC	Bloom, Harry	682 2d St., Fall River, Mass.	.5
1EAP	Bowers, M. A.	13 Belmont Ave., Camden, Me.	.5
1EAU	Bowers, Wm. K.	6 Samoset St., Dorchester, Mass.	.5
1EAJ	Brassill, Jas. J.	East Providence, R. I.	.5
1EIC	Chesbro, Everett L.	54 High St., Mystic, Conn.	.5
1EMH	Copeland, Sylvester W.	656 2d St., Fall River, Mass.	.5
1EAD	Courtney, Roger D.	98 W. Springfield St., Boston, Mass.	.5
1EMV	Dean, J. Marshall	46 Alderman St., Springfield, Mass.	.5
1EMJ	De Lancey, Clyde P.	Hampton, N. H.	.5
1EMD	De Lano, Ralph B.	76 Hancock St., Stoneham, Mass.	.5
1EMK	Dock, Luther	59 Granite St., Westerly, R. I.	.5
1EAQ	Downes, Geo. H.	323 Edgewood Ave., New Haven, Conn.	.5
1EIN	Eaton, Louis F.	165 Belmont St., Brockton, Mass.	.5
1EIO	Estabrooks, Roland W.	33 Parkland Ave., Lynn, Mass.	1
	Fall River State Armory.	(See Norwell, Joseph C.).	
1EAT	Feeney, Paul F.	80 Crest Ave., Revere, Mass.	.5
1EMZ	Fortier, Ralph L.	248 Fort Pleasant Ave., Springfield, Mass.	.5
1EAZ	Furrier, Joseph P.	19 Tudor St., Lynn, Mass.	.5
1EAC	Hardy, Ralph	19 Parkman St., Boston, Mass.	.5
1EIH	Heffernan, Edmund J.	369 Main St., New Britain, Conn.	1
1EMQ	Heidel, Edward O.	29 Hollister St., Pittsfield, Mass.	.5
1EIP	Hudder, Paul B.	222 Eastern Ave., Gloucester, Mass.	.5
1EMT	Hoopes, Thomas T.	118 High St., Newburyport, Mass.	.5
1EAR	Jacques, Arthur E.	52 Newton St., Marlboro, Mass.	.5
1EIJ	Knight, Winfield W.	105 Chestnut St., Camden, Me.	.5
1EAO	La Marche, Harold E.	70 George St., Attleboro, Mass.	.5
1EIV	Lawyer, Lanphere R.	27 Barnett St., New Britain, Conn.	.5
1EIE	Leidel, Ralph J.	28½ Warren St., Providence, R. I.	.5
1EIM	Lewis, Kenneth P.	124 Maplewood Ave., Gloucester, Mass.	.5
1EIL	Loheed, Wm. J., Jr.	12 Clifton Ave., Campello, Mass.	.5
1EIY	Loomis, Geo. A.	119 S. Main St., St. Albans, Vt.	.5
1EMB	Lovejoy, Julian	Littleton, Mass.	1
1EIX	Man, Edward H.	North Stonington, Conn.	.5
1EAW	Marshall, Robert E.	2 Pleasant Pl., Marlboro, Mass.	.5
1ENA	Martin, Paul S.	79 7th St., Turners Falls, Mass.	1
1EAY	McCarthy, Geo. E.	20 Belden St., New Britain, Conn.	.5
1EME	Morrison, Raymond D.	17 Malbone Ave., Newport, R. I.	.5
1EIU	Murphy, Charles F.	54 Essex St., Marlboro, Mass.	.5
1EAF	Norwell, Joseph C.	Fall River, Mass.	.5
1EMP	Petrie, Andrew L.	22 Lamberton St., New Haven, Conn.	.5
1EMG	Polleys, Wm. V., Jr.	606 Public St., Providence, R. I.	.5
1EMR	Poole, Willard H.	229 Belmont St., Fall River, Mass.	.5
1EAG	Reeves, Clarence E.	37 Edgewood St., Roxbury, Mass.	.5
1EAM	Remington, Frederick H.	269 St. Botolph St., Boston, Mass.	.5
1EMU	Rogers, Harold A.	39 Paulena St., West Somerville, Mass.	.5
1EML	Ryder, Malcolm P.	86 Calhoun St., Springfield, Mass.	.5
1EIG	Sacs, Jas. G.	124 Prairie Ave., Providence, R. I.	.5
1EMF	Stacy, Frank A.	7 Dodge Court, Danvers, Mass.	.5
1EMN	Straub, Alphonse B.	151 S. Elm St., Waterbury, Conn.	.5
1EAN	Swanton, Wm. A.	42 Dix St., Dorchester, Mass.	.5
1EIK	Tarment, Ralph E.	381 Main St., Everett, Mass.	.5
1EAV	Tatreault, Ernest	Northbridge, Mass.	.5
1EIQ	Taylor, Alfred C.	788 Hope St., Providence, R. I.	.5
1EAS	Taylor, David F.	55 Bromfield St., Wollaston, Mass.	.5
1EIA	Tobey, Harold A.	42 Pomeworth St., Stoneham, Mass.	.5
1EIF	Towner, F. Bruce	133 Belmont St., Everett, Mass.	.5
1RIB	Walker, Leon F.	45 Nixon St., Dorchester, Mass.	.5
1EII	Wallace, Malcolm E.	6 Witherbee Ter., Marlboro, Mass.	.5
1EIW	Walter, Howard S.	Melrose, Mass. (portable station)	.5
1EAL	Weeks, Walter R.	47 Pleasant St., Marlboro, Mass.	1
1EMW	White, Elmir L., Jr.	61 Shurtleff St., Chelsea, Mass.	.5
1EMX	Wiesemeyer, Max L. A.	Stonington, Conn.	.5
1EMY	Young, Frank A.	525 W. Main St., Meriden, Conn.	.5
	SECOND DISTRICT		
2AMA	Ackerman, Rudolph W.	Scarsdale, N. Y.	1
2ANL	Adams, Chester B.	41 Osborn St., Keyport, N. J.	.5
2AMV	Adolph, Herbert	1167 Clay Ave., New York, N. Y.	.5

(To be continued)

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

RADIO SET OF HOWARD WHITE.

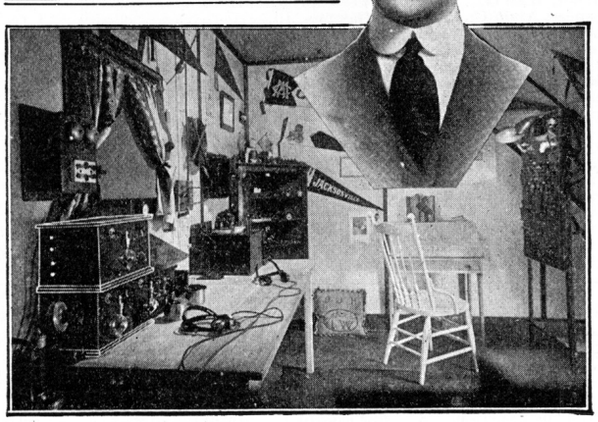
Herewith is a photograph of my sending and receiving station, which is described below:

My sending set comprises the following: 1 K. W. transformer, Murdock condensers, oscillation transformer, aerial inductance, rotary gap with speed of 8,000 R. P. M. and commercial key.

Receiving set consists of: Navy type tuner, two variable condensers, Audion detector and amplifier; the latter two instruments of the writer's own manufacture.

The apparatus are controlled by the large switch-board shown at the right-hand side of the picture.

Mr. Howard S. M. White, Prize Winner This Month. He Obtains Excellent Results, Both Transmitting and Receiving, with His Radio Set, Which Is Quite Complete as Becomes Apparent. Note the Neat Arrangement of the Lay-Out.



Though my aerial is only ninety feet long and seventy-five feet high I have obtained very remarkable results, working daily with 9 B. W. of Omaha, Neb., and 9XT of Lincoln, Neb., a distance of over a hundred miles. Time signals can be heard in the daytime from Arlington, Key West and Springfield. We are able to hear stations on the Atlantic, Pacific and Gulf Coasts, as well as many ship stations in either ocean.

I have been a student of wireless for the past four years. Am a member of the American Radio Relay League, the Central Radio Association, the Hawkeye Radio Association and have a Government license; call 9JH.

HOWARD S. M. WHITE.

Sioux City, Iowa.

On February eighth, the governor of Bombay, India, closed a switch on the 100,000 volt transmission line of the Tata high head system, and energy was transmitted to Bombay for the first time from the power house, forty-three miles away.

RADIO STATION OF W. A. SOMERS.

For sending I have a 1 K. W. Edgcomb-Pyle transformer, a line protector plate condenser, rotary spark gap and an oscillation transformer, which is at the left of the picture. I also use a ½ K.W. Electric Importing Company transformer with this set. At the right I have a small sending set for town use. This consists of a 1" spark coil, home-made oscillation transformer, spark gap, condenser and hot wire meter.

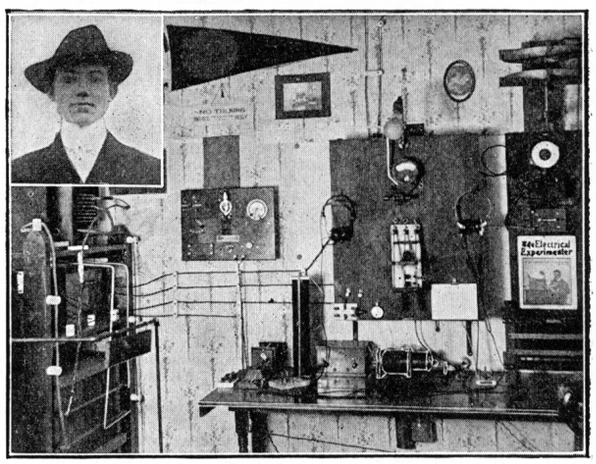
The receiving set consists of a single step amplifier, two pairs of 'phones, Murdock and Western Electric make; two loose couplers, one of which is connected with a loading coil for receiving NAA.

My aerial is 50 ft. high, 60 ft. long, six wires each two feet apart, made of seven-strand phosphor bronze wire.

I hold a second grade commercial radio operator's license and my official call is 8 A N N.

WARREN A. SOMERS.

Bradford, Pa.



Elaborate Radio Station of Mr. Warren A. Somers, Comprising Both Transmitting and Receiving Apparatus. Switch-Boards Simplify the Control of the Various Instruments.

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250 AMATEURS TAKE REPORTS IN IOWA.

There are now more than 250 amateur wireless stations in the state of Iowa, according to Professor C. A. Wright of Ames. Practically all are receiving the weather and news reports sent out twice daily from the big wireless station at Ames.

"It is our intention to continue the news service right on through the season," says Professor Wright. "The service is to be improved as soon as feasible and blanks furnished those who want them for bulleting news sent out." The idea of adding general news items to the college news furnished is being favorably considered.

WATCH FOR THE "WIRELESS GIRL" IN NEXT ISSUE!

RADIO SET OF G. M. COTTRELL.

The aerial of my station is composed of four wires, 60 feet high and 150 feet long. My receiving outfit consists of a Murdock 4,000 meter loose coupler, Crystaloi detector with resonator and constant amplitude buzzer, Murdock primary and secondary variables, a tikker, two Murdock large fixed condensers, Brandes' 3,000 ohm headset.

For sending I use an E. I. Co. ½ K. W. coil, electrolytic interrupter, large and small sending condensers, helix with pilot lamp and heavy contact key.

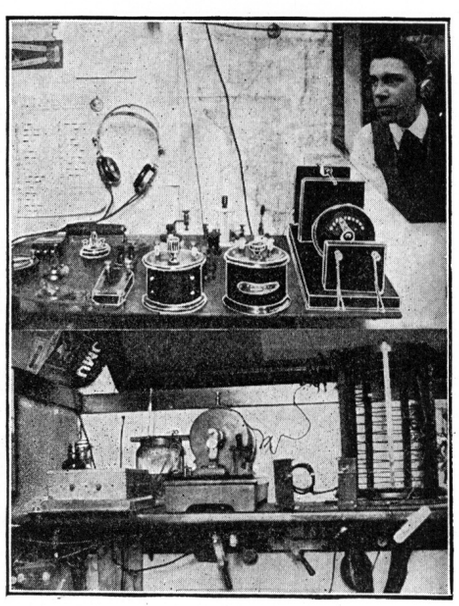
I have been a wireless experimenter for five years and THE ELECTRICAL EXPERIMENTER has been my chief help in most of the work undertaken.

I talk nightly with several amateurs thirty-five miles away. I use only half of my aerial when sending. My greatest receiving range is Key West, about 1,900 miles air line. With the tikker I hear Sayville's war news. I have heard N A A during heavy rain and snow storms.

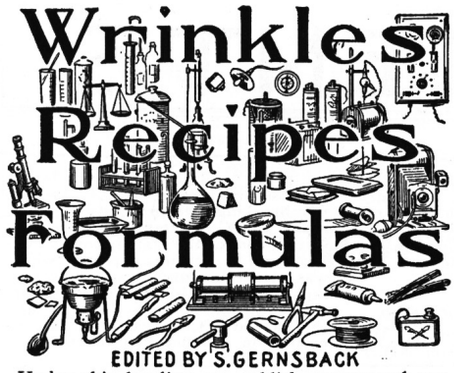
My tikker is only a home-made instrument, and I am thinking of applying for a patent on it because its operation has proved very successful.

GORHAM COTTRELL.

Quincy, Ill.



Upper View Shows Mr. Cottrell's Wireless Receiving Set; Below—His Transmitting Apparatus.



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 25.
Ormolu Coloring Lacquers, Etc.

Ormolu Coloring.—Alum, 30 parts; nitrate of potassa, 30 parts; red ochre, 30 parts; sulphate of zinc, 8 parts; common salt, 1 part; sulphate of iron, 1 part. It is applied with a soft brush. The articles are placed over a clear charcoal fire until the salts, melted and dried, assume a brown aspect. They are then suddenly cooled in nitric acid water, containing 3 per cent. of hydrochloric acid, afterwards, washed in abundance of water and dried in sawdust.

To Prepare Brass Work for Ormolu Dipping.—If the work is oily, boil it in lye, and if it is finished work, filed or turned, dip it in old acid, and it is then ready to be ormolued, but if it is unfinished and free from oil, pickle it in strong sulphuric acid, dip in pure nitric acid, and then in the old acid, after which it will be ready for ormoluing.

To Repair Old Nitric Acid Ormolu Dips.—If the work after dipping appears coarse and spotted, add vitriol till it answers the purpose: if the work after dipping appears too smooth, add muriatic acid and nitrate till it gives the right appearance. The other ormolu dips should be repaired according to the receipts, putting in the proper ingredients to strengthen them. They should not be allowed to settle, but should be stirred often while using.

Directions for Making Lacquer.—Mix the ingredients, and let the vessel containing them stand in the sun, or in a place slightly warmed, 3 or 4 days, shakig it frequently till gum is dissolved, after which let it settle from 24 to 48 hours, when the clear liquor may be poured off for use. Pulverized glass is sometimes used in making lacquer to carry down the impurities.

Lacquer for Dipped Brass.—Alcohol, (95 per cent.) 2 gals.; seed lac, 1 lb.; gum copal, 1 oz.; English saffron, 1 oz.; annatto, 1 oz.

Lacquer for Bronzed Brass.—To 1 pt. of the above lacquer add gamboge, 1 oz., and, after mixing it, add an equal quantity of the first lacquer.

Deep Gold Colored Lacquer.—Best alcohol, 4 ozs.; Spanish annatto, 8 ozs.; turmeric, 2 drs.; shellac, ½ oz.; red sanders, 12 grs.; when dissolved, add spts. of turpentine, 30 drops.

Deep Gold Colored Lacquer for Brass Not Dipped.—Alcohol, 4 gals.; turmeric, 3 lbs.; gamboge, 3 ozs.; gum sandarac, 7 lbs.; shellac, 1½ lbs.; turpentine varnish, 1 pt.

Gold Colored Lacquer for Dipped Brass.—Alcohol, 36 ozs.; amber, 2 ozs.; gum gutta, 2 ozs.; red sandal wood, 24 grs.; dragon's blood, 60 grs.; oriental saffron, 36 grs.; pulverized glass, 4 ozs.

Gold Lacquer for Brass.—Seed lac, 6 ozs.; amber or copal, 2 ozs.; best alcohol, 4 gals.; pulverized glass, 4 ozs.; dragon's blood, 40 grs.; extract of red sandal wood obtained by water, 30 grs.

Lacquer for Dipped Brass.—Alcohol, 12 gals.; seed lac, 8 lbs.; turmeric, 1 lb. to a gal. of the above mixture; Spanish saffron, 4 ozs. The saffron is to be added for bronzed work.

Good Lacquer.—Alcohol, 8 ozs.; gamboge, 1 oz.; shellac, 3 ozs.; annatto, 1 oz.; solution of 3 ozs. of seed lac in 1 pt. alcohol. When dissolved, add ½ oz. Venice turpentine, ¼ oz. dragon's blood, will make it dark. Keep it in a warm place 4 or 5 days.

Pale Lacquer for Tin Plate.—Best alcohol, 8 ozs.; turmeric, 4 drs.; hay saffron, 2 dr.; dragon's blood, 4 drs.; red sanders, 1 dr.; shellac, 1 oz.; gum sandarac, 2 drs.; gum mastic, 2 drs.; Canada balsam, 2 drs.; when dissolved, add spts. turpentine, 80 drops.

Red lacquer for Brass.—Alcohol, 8 gals.; dragon's blood, 4 lbs.; Spanish annatto, 12 lbs.; gum sandarac, 13 lbs.; turpentine, 1 gal.

Pale Lacquer for Brass.—Alcohol, 2 gals.; cape aloes, cut small, 3 ozs.; pale shellac, 1 lb.; gamboge, 1 oz.

Best Lacquer for Brass.—Alcohol, 4 gals.; shellac, 2 lbs.; amber gum, 1 lb.; copal, 20 ozs.; seed lac, 3 lbs.; saffron to color; pulverized glass, 8 ozs.

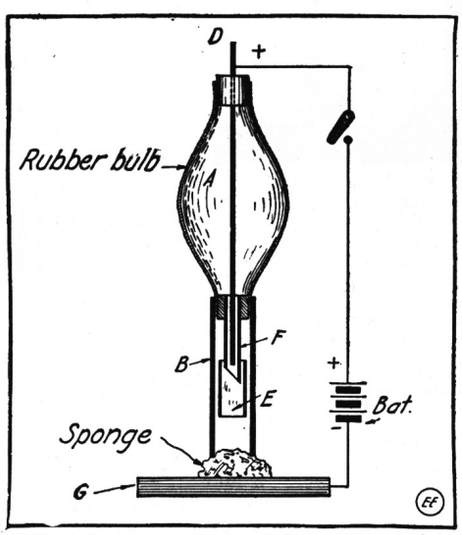
Color for Lacquer.—Alcohol, 1 qt.; annatto, 4 ozs.

Gilder's Pickle.—Alum and common salt, each, 1 oz.; nitre, 2 ozs.; dissolved in water, ½ pt. Used to impart a rich yellow color to gold surfaces. It is best largely diluted with water.

S. G.

A HAND ELECTROPLATING OUTFIT.

The plating outfit consists of a rubber ball, A, fitted at one end with a glass tube,



A Neat System of Electroplating, Eliminating the Usual Muss and Trouble.

B, which carries a small sponge. Rod D passes through the rubber ball into the glass tube, B, and carries at that end the anode E. A small glass tube, F, also connects the rubber ball with the larger tube, B. The connections from the battery to the cathode G, the object to be plated, and to the projecting end of the anode carrying rod D are made as in the diagram. The rubber ball is filled with the electroplating fluid and is squeezed so as to force the fluid through the small tube, F, into the larger tube, B, filling it and soaking the sponge.

The current is then turned on and by moving the wet sponge over the cathode, G, the latter will be plated.

Contributed by GEO. SWANDA.

HOW TO PREVENT PEN POINTS FROM GETTING RUSTY.

To prevent pens from becoming rusty place a few old pen points (or some pieces of iron wire) in your ink supply. The pens eat up the acid in the ink and thereby keep your pen free from the acid.

Contributed by
ALEXANDER V. BOLLERER.

POLE TEST PAPER.

Undoubtedly many amateur electricians have been annoyed by the trouble in finding which was the positive, and which was the negative of the two wires, especially when the source of current could not be reached or where the wires were twisted so as to make it difficult to distinguish one from the other. In storage cells and batteries the poles are frequently not marked and to find the positive and the negative poles one will have to resort to a polarity indicator, which is an expensive instrument for most experimenters.

A simple method of getting rid of this annoyance with but little expense is as follows: At a drug or chemical store procure some red litmus paper and thoroughly soak it in a solution of one tablespoonful of salt in a tumbler full of water. When thoroughly soaked remove the paper from the solution and carefully, so as not to tear it, hang it up to dry in such a manner that it will not touch anything but the means of support.

NOTE:—Do not try to dry the paper between sheets of blotting paper as this will absorb some of the salt solution and render the pole test paper insensitive to small voltages.

When dry the pole test paper is ready for use. It is used as follows: Take a strip of the paper measuring about one-half inch by one and one-half inches and moisten it slightly with water. Then place the ends of the wires to be tested on the paper in such a position that they will be about three-quarters of an inch apart.

If there is a potential difference (voltage) between the two wires, a deep red spot will appear on the paper at one of the wires and a blue spot will appear at the other wire. The wire at which the blue spot appears is the *negative* and the one at which the red spot shows up is the *positive*.

When the potential difference between the wires is low the red spot will sometimes not show. As the blue spot, however, will appear, it will indicate the negative wire; the other, therefore, being positive.

If you cannot obtain red litmus paper, use blue litmus paper instead. The blue spot, however, will not show up very noticeably in this case, but the red spot will indicate the positive wire and the other wire will therefore of necessity be the negative one.

If unable to procure litmus paper, it can be prepared as follows: Boil some red cabbage leaves in water until a concoction of a deep reddish purple is obtained. Treat this concoction with a few drops of white vinegar until it turns to a brighter red color. Into this solution dip pieces of filter, blotting or unglazed paper. When dry the color of the paper should be a deep pink. If it is lighter the red cabbage solution should be boiled longer. The paper thus treated can then, after drying, be treated with the salt solution to make the pole test paper as previously described.

After using pole test paper it can be dried and laid aside to be used over again. After it is worn out it may be renewed as follows: Dip into vinegar until all blue spots disappear, then dip into water so as to remove the vinegar, then soak in salt solution as described above and the paper will be as good as new. This can be repeated any number of times until the paper tears.

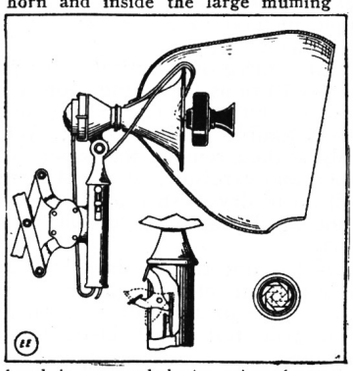
Contributed by K. KIRSCH and F. L. BUCHHOLZ.

LATEST PATENTS

Novel Combination Telephone

(No. 1,180,147; issued to Rosa D. Hatch.)

This unique combination telephone transmitter and receiver involves the use of a horn on the receiver to amplify the sound. In front of the horn and inside the large muffling

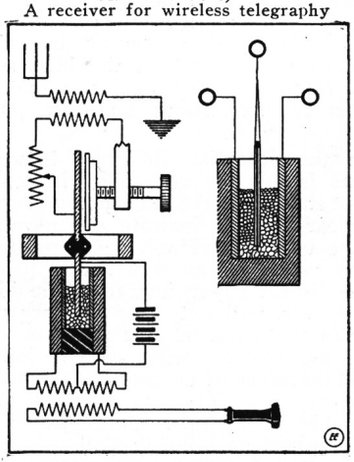


hood is suspended the microphone. One may thus hear without placing the receiver to the ear and the incoming sounds are, moreover, directed, by virtue of the hood, to the ears of the person using the instrument. An iris diaphragm is fitted to the receiver horn to adjust the resonance of the sound chambers.

Radio Detector.

(No. 1,179,906; issued to Reginald A. Fessenden.)

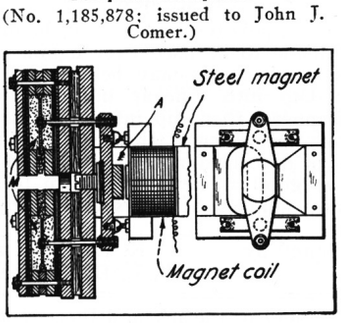
A receiver for wireless telegraphy



comprising a movable mica diaphragm, a platinum leaf thereon, a fixed plate statically attracted by said movable plate, a microphonic material between the movable and fixed plates, whereby the motion of the movable plate may be indicated by variation of resistance of said microphonic material. The device acts as an amplifier and Dr. Fessenden states that it has proved superior in sensitiveness to the liquid barretter.

Telephone Amplifier

(No. 1,185,878; issued to John J. Comer.)

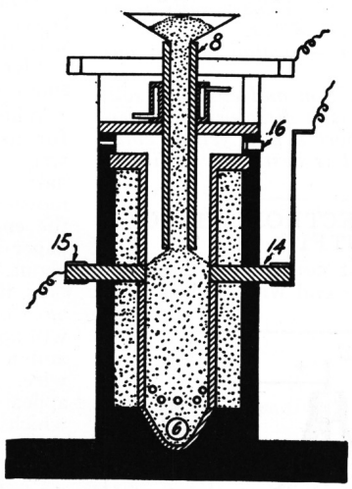


Improved telephonic amplifier device incorporating a steel "U" magnet, an electro-magnet coil, actuating an iron armature "A", attached by tie rods to diaphragms of two microphones M. Armature "A" spring mounted. Felt rings absorb all extraneous sound waves. Adapted to commercial voltage circuits and capable of controlling as many as 500 loud speaking reproducers from a single master transmitter attached to a phonograph or used in the regular way to gather up speech sounds.

Electric Furnace

(No. 1,184,817; issued to J. W. Brown.)

An electric furnace intended especially for fusing or treating finely divided carbon. The latter is fed downward through a hollow electrode as indicated. The electrode is cooled by a water jacket. The treated material passes through an

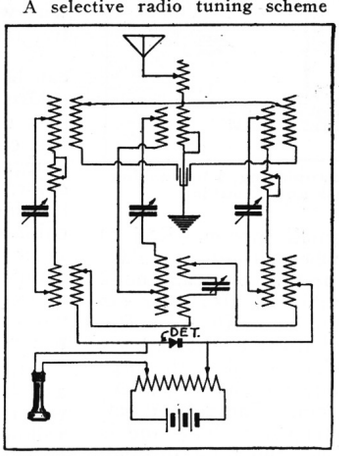


orifice 6 at the base. Single or polyphase A.C. may be used with this furnace. Current passes through the hollow electrode 8 and two side electrodes 14 and 15. Hot gases may be removed through a side opening 16.

Radio Tuning Scheme

(No. 1,184,843; issued to Reginald A. Fessenden.)

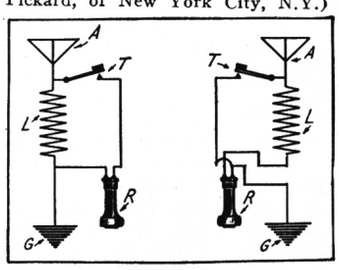
A selective radio tuning scheme



relating to methods of weeding out disturbances, such as signals from other stations, utilizes three circuits, all very sharply tuned and with very small damping so as to allow a larger resonant rise; one circuit being tuned to the period at which it is desired to receive, one tuned to a higher period and the other to a lower period. The higher and lower circuits may be made to neutralize the effect of disturbing impulses produced on the receiver by the properly tuned circuit. Involves the use in some cases of a mono-telephone receiver as described in patent. With the receiver tuned to group and wave frequencies the inventor claims entire freedom from all disturbances, is attained.

Detector-less Receiver for Radio

(No. 1,185,711; issued to G. W. Pickard, of New York City, N.Y.)

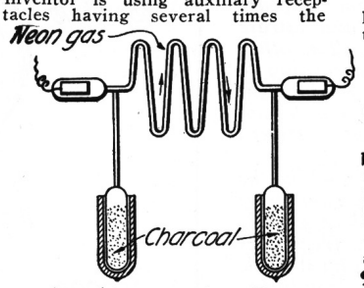


Improved method, it is claimed, of interpreting received radio signals from spark or undamped wave stations, which consists of storing the energy of the incoming oscillations around an inductance in the form of a magnetic field, and then discharging this stored energy in the form of a pulse of current, this action resulting from a vibrating interrupter T. With spark sending the inventor has attained good results with simply a key at T operated by hand. Adaptable also to radio-telephony. The radio frequency current here operates the one ohm 'phone directly without any detector.

Neon Tube

(No. 1,189,664; issued to Georges Claude.)

To supplement the usual methods used to purify neon gas, a French inventor is using auxiliary receptacles having several times the

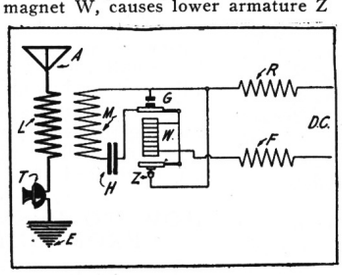


capacity of a neon tube. By passing a spark through the tube a respiration takes place between the charcoal in the receptacles and tube, conversely. Using a more intense cold than liquid air, such as liquid hydrogen, a circulation of gas can be created in the tube, while the spark is only employed to release the impurities.

Radio Spark Gap Device

(No. 1,186,455; issued to W. Torikata, E. Yokoyama and M. Kitamura.)

A self-regulating spark gap for use on direct current service, suited to the production of high frequency currents in a tuned circuit GMH. The D.C. passing through electromagnet W, causes lower armature Z

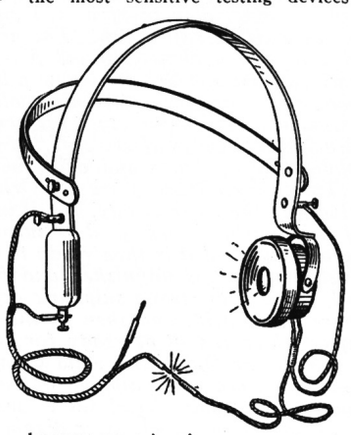


to break coil circuit, inducing a high self-inductance E.M.F. capable of breaking down resistance of spark gap G. After passage of the initial spark, the gap becomes ionized and a strong current, which was at the beginning cut off by the high resistance in the electrode circuit, will be able to flow through the gap circuit. Great constancy in oscillation production is claimed.

Phone Tester for Electric Circuits

(No. 1,187,500; issued to G. B. Raymond.)

Effective testing instrument for locating short and open circuits in electric wiring or dynamo and motor windings. It comprises an ordinary telephone receiver, headband, flashlight battery and test cords. The battery fits into a neat metal casing mounted on side of the head band as shown. The 'phone, so used, constitutes one of the most sensitive testing devices

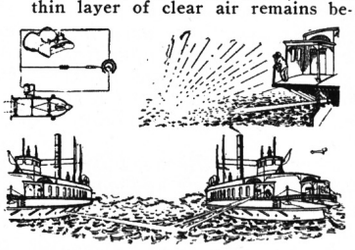


known, superior in many ways to the galvanometer.

Fog Signaling Device for Ships

(No. 1,184,783; issued to G. B. Speed.)

Intermittent light beam, controlled by electrically actuated shutter in reflector hood, is played on water from a low altitude. Observer on opposite boat uses binoculars fitted with shutter which cuts off view whenever intermittent flashes are sent out from his vessel. System operates on the principle that fog is less dense near the water, as a thin layer of clear air remains be-



tween fog and water. It is intended to aid prevention of collisions.

In order that the observer, who as explained above should be located on the vessel as near the water line as possible, may not be dazzled by the reflection from the fog due to the light from his own vessel, special shutter spectacles are provided. As shown these spectacles are provided with a shutter operated in synchronism with the porthole shutters. The spectacle-shutter may consist of a lever at each end of which is a disk adapted to cover the opening or object glass of the spectacles. This lever may carry an armature adapted to co-operate with an electromagnet, the latter receiving current at the proper interval from the controller.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

WATT ISAWATT, OF KURRENT, D. C.

AERO BED FIRE ESCAPE

No. & $\sqrt{=}\frac{1}{CUSO_4}$ **Specifications Specialized** **Patent Appled**

To Whom It Mought Concert:

Be it beknown that I, Watt Isawatt of the City of Kurrent in the State of Dreadful Consternation have promulgated and preconceived certain new improvements in life saving apparatuses.

It is a well known geographical fact, already beknown to the ancients, that when a fire breaks out on the upper floors of a dwelling, panicstroked bipeds of the class of *homo sapiens* suddenly are seized with an uncontrollable desire to learn the art of flying. Being deprived of wings the experiment usually fails, *i.e.*, the luckless flyers as a rule land on their *Coko Cranikums* thereby doing great damage to the concrete more fully under and overstood from the below appearing descriptive description:

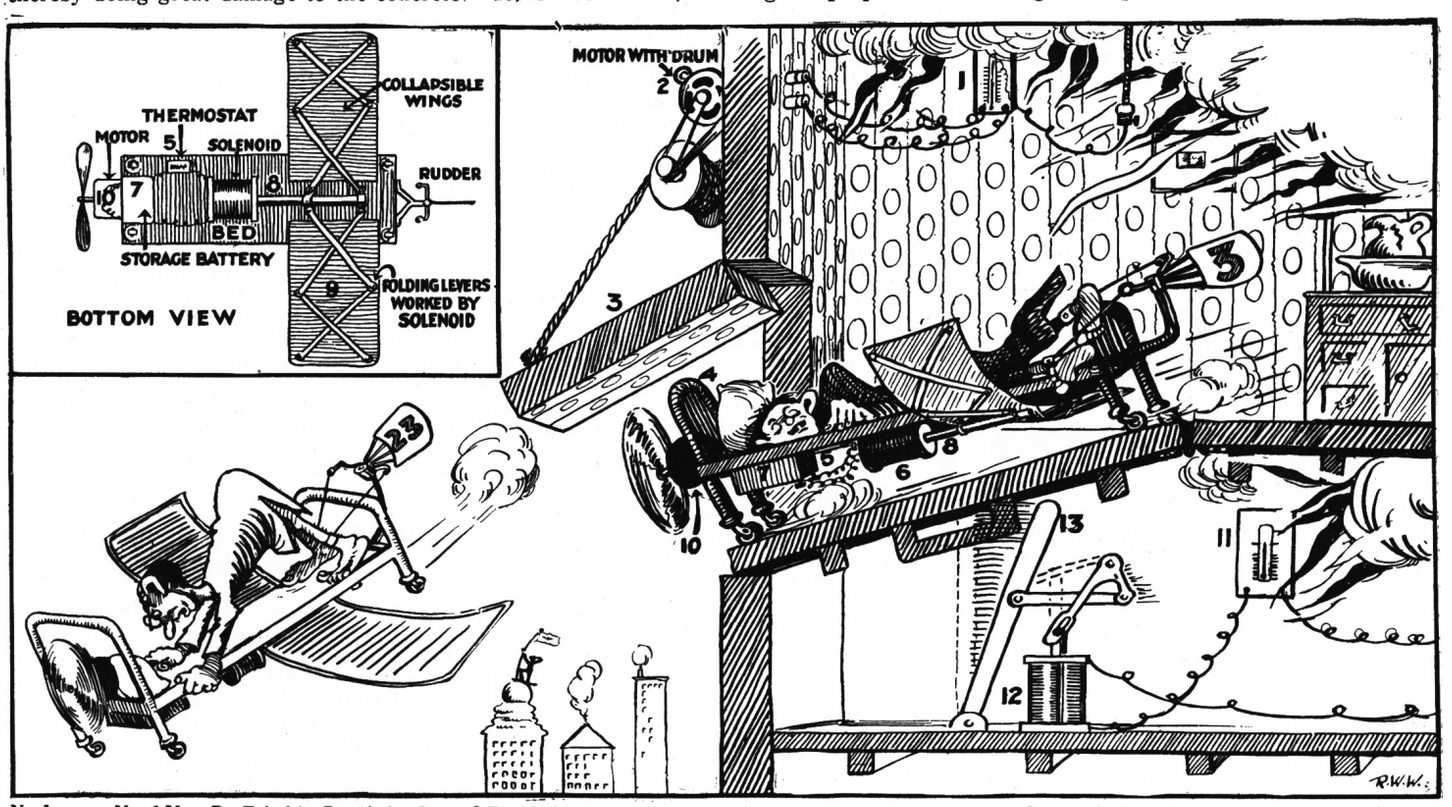
This is the *modus operansky* of the aero-bed 'fire escape'. When a fire breaks out in a skyscraper, the heat actuates thermostat 1, which closes the motor circuit, and the motor, 2, raises a section 3 in the side of the building. 4 is an ordinary (very ordinary) bed, equipped with castors (not castor oil) or landing skids.

Thermostat 5, under the bed operates at 1° higher than 1. When the thermostat closes, the solonoid 6 (see insert), operated by storage battery 7, draws in plunger 8, and spreads out the wings 9. The motor, 10, is also started, whirling the propeller at

It is a well known caloric fact that fever patients are apt to become hot, or rather heated. Cases are known where the fever has gone up so high as to set fire to the mattress. High fever cases also heat up the ward in an annoying manner. Thanks to my invention this can never happen, for, when the patient becomes sufficiently hot, the thermostat 5, under the bed acts and he departs hurriedly. By means of an automatic steering arrangement, the aero-bed returns to the ward as soon as the patient has cooled down sufficiently.

What I claim is:

1° An aero-bed-fire-escape apparatus enabling municipalities to save sidewalks from



No Longer Need You Be Fried to Death in Case of Fire While Asleep in a Tall House. Thanks to Mr. Watt Isawatt's Aero-Bed-Fire-Escape Your Exit to Safety Is Made Automatically and You Get a Free Ride Besides.

sidewalks. At the present high cost of cement (due to the shortage of imported air, on account of the war and the English censure of the mails) it becomes necessary to find ways and means to prevent the useless and widespread destruction of the sidewalks.

In a separate Pattent Applification I describe how the cement or concrete sidewalk can be made so elastic that amateur flyers landing on their *Coko Cranikums* will bounce up and down for a certain length of time, the time being directly proportional to the square root of the density of their *Cranikums.*

In the present, unintelligible presentation however, the ethnological means is arrived at by a different manner, as will be a tremendous rate. The bed is then ready to fly away as soon as thermostat 11 closes circuit through solenoid 12. This draws away the floor support 13, and drops the floor with such force that the bed makes a sudden dive for freedom. Steering is then accomplished by means of the rudder and one's feet.

After the Biped is properly awakened he can fly around the block till breakfast time if he so chooses. Or if he has foresight enough to corral his clothes to the bed in the evening, he can dress *en route* and fly directly to his office, in order to beat the office boy to it and call him down because he is 3¼ minutes late.

A highly important use of my invention is also found in its application for hospitals. destruction.

2° A flying-bed-aero pleasure vehicle enabling tired business Bipeds to watch a blaze from the front rank.

3° An aero-fire-escaping bed, enabling beds to escape the fire by aero, and enabling the fire to escape the aero-beds.

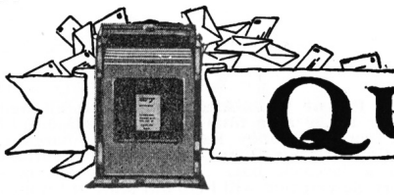
In witness thereunder I have emplaced hereon my phizst this here 19th night of Achdulieberaugust 19½6.

(Signed) WATT ISAWATT,

By his Attorney,
Raymond Anderson.

Fitnesses:

B. Y. Heck.
P. A. Tent.
F. Lea Byte.



QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

VARIOMETER.

(597.) E. Dawlson, Santa Fé, N. Mex., inquires:

Q. 1. Can an ordinary loose coupler be used as a variometer?

A. 1. Yes, providing the windings of both the primary and secondary coils are wound with the same size wire and of a large size. The primary coil is connected in series with the secondary in such a manner that their magnetic fields oppose each other. Results obtained with such an arrangement will not be as efficient as if the coupling is varied at right angles to each other. In this case a large space is necessary in order to obtain the same amount of coupling as if the coils were turned at angle to each other, as in the standard type variometer.

Q. 2. Would the sensitiveness of crystal detectors be increased if they were heated?

A. 2. Some rectifying crystals increase their sensitiveness when they are slightly heated, such as molybdenum and silicon. This is done by placing the whole detector on a sand bath, which is heated either by an alcohol torch or a bunsen burner. It should not be heated more than about 5 to 8 degrees above the surrounding atmosphere.

PHOTO ELECTRICITY.

(598.) P. Gilsen, Providence, R.I., asks:

Q. 1. What is photo electricity?

A. 1. Photo electricity is the property possessed by certain elements of emitting electrons or negatively charged particles when exposed to sunlight, in such a manner that one element is entirely shielded from the light while the second one is highly exposed to it.

The study of photo electricity is still in its infancy, and the subject is still open for extensive research.

Q. 2. What is the chemical formula for glyceryl stearate, and what is its chemical reaction with sodium hydroxide?

A. 2. The formula for glyceryl stearate is $C_3H_5(C_{18}H_{35}O_2)_3$, and its chemical reaction with sodium hydroxide is $C_3H_5(C_{18}H_{35}O_2)_3 + 3NaOH = C_3H_5(OH)_3 + 3NaC_{18}H_{35}O_2$. The last product of the reaction is called sodium stearate or hard soap. Soft soap is produced by using potassium hydroxide instead of sodium hydroxide.

ARMATURE.

(599.) John Haysel, Pittsburgh, Pa., wishes to know:

Q. 1. What is the armature of a dynamo?

A. 1. The armature is the part of the machine in which the E. M. F. is produced, or in which the current is generated. As a rule the armature revolves and the field is stationary, but in a few alternators the armature is stationary and the field coils revolve.

Q. 2. Could a pair of high resistance telephones be used in the grid circuit of an oscillating audion, instead of an inductance coil?

A. 2. Yes.

Q. 3. Does a dynamo or motor always have an even number of poles?

A. 3. There are as many "north" as there are "south." The poles are sometimes divided differently, but the north and south poles are equal in number.

TRANSFORMER.

(600.) Charles Appleby, Newburg, N.Y., asks:

Q. 1. Does the resistance of the primary circuit of a transformer change, so as to let more current pass when the secondary gives more current?

A. 1. No. The true or D.C. resistance of the primary circuit remains constant. However, Ohm's law in its simple form does not always hold true for alternating currents. For instance, when the primary circuit of the transformer has a resistance of about 30 ohms, more than 330 amperes may pass when such a resistance is connected across a 1,000 volt D.C. circuit, but only a fraction of this current would pass at the same potential on an A.C. circuit due to the impedance reactance.

Q. 2. Will the load be evenly divided if two transformers have the secondaries connected in multiple?

A. 2. It will if the two transformers have similar regulations; that is, if the voltage drops off the same amount at half load, or at full load.

Q. 3. How does Ohm's law apply to a circuit containing counter-electromotive force?

A. 3. The C. E. M. F. may be considered as reducing the total E. M. F. and Ohm's law becomes: current equals E. M. F. minus C. E. M. F. divided by resistance, therefore I=E. M. F.—C. E. M. F.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 letters addressed to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually published.

Kindly note, therefore, that in the future we can not, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first three ordinary questions and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addressed envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

BATTERY.

(601.) Paul Stutz, Albany, N.Y., inquires:

Q. 1. What is a voltaic or galvanic battery?

A. 1. These are simply different names for chemical batteries. Volta and Galvani are the two men who divide honors for discovering the principle and inventing the battery cells bearing these names.

Q. 2. What is the difference between a primary and secondary battery?

A. 2. When a primary battery is exhausted, it is necessary, as a rule, to throw away the electrolyte and supply a new one, also frequently renewing the electrodes. Storage batteries are recharged by sending a current through them in the opposite direction from that which the battery delivers, the same electrolyte and electrodes being used over and over again. In the secondary or storage battery there is no actual *storing* of electricity. The charging current reverses certain chemical actions and the energy that is stored is *chemical* rather than *electrical*. The only case where electricity is actually stored is in the condenser or Leyden jar.

METALLIC FLAME LAMP.

(602.) J. Russel, Denver, Colo., wants to know:

Q. 1. What is a metallic flame lamp?

A. 1. In these lamps the negative electrode furnishes the material for the arc vapor and consists of a thin steel tube, packed with oxides of metals, such as iron (magnetite) titanium or chronium. In vaporizing, they add great luminosity to the arc, leaving a considerable amount of fluffy soot behind, however, which is carried away by special ventilation means. One electrode is directly above the other.

Q. 2. Is any use other than lighting made of the high temperature of the arc?

A. 2. Various processes for welding metals and for the reduction of metals or other metallurgical work have been developed both from the heat of the arc and also from the heat from the ordinary operation of the current.

Q. 3. What is meant by a sinusoidal current?

A. 3. A sinusoidal current is a common variety of alternating current in which the current gradually increases from zero to a maximum positive value. It then becomes weaker until it reaches zero, changing direction and gradually rising to a maximum negative value and so on.

(*Continued on page 354*)

THE WIRELESS TELEPHONE

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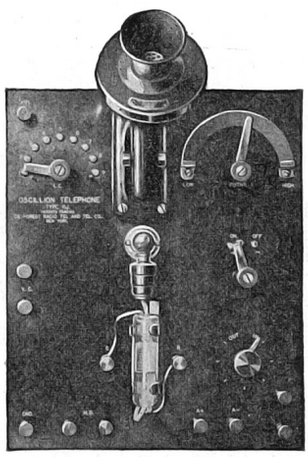

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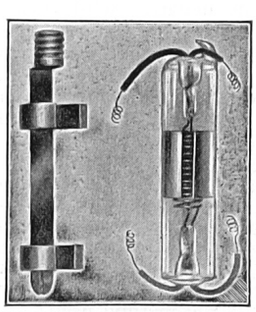

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Adapter 40 cents extra.

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It is not affected by mechanical vibration nor burned out by static or the transmitting spark. It never fails at the critical moment.

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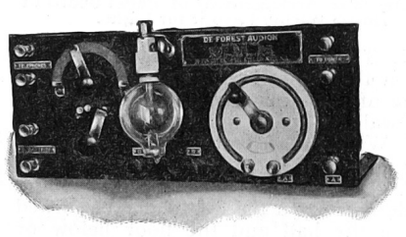
The genuine De Forest Audion is now within the means of every operator.



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WARNING—You are entitled to the genuine Audion, guaranteed by the owners of the Audion patents, when making an investment of this kind. Any evacuated detector having a filament, a grid and a plate, as well as other types, are covered by our patents, and several irresponsible infringers are being prosecuted. To be safe and get full value for your money, insist on the genuine De Forest Audion.

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QUESTION BOX.

(*Continued from page 352*)

CARBORUNDUM.

(603.) P. Fletcher, Richmond, Va., inquires:

Q. 1. How is ordinary carborundum made, and give the chemical reaction?

A. 1. The material is made in an electric furnace from a mixture of sand, coke, sawdust and salt. The real action is in the sand, which is an oxide of silicon SiO_2, often called silica. The mixture facilitates the escape of gases. The salt seems to act as a sort of flux. At the high temperature the silica is dissociated, the silicon melting with carbon (from the burned sawdust) to form carbide of silicon SiC, and its oxygen uniting with other carbon to form carbon monoxide CO, which then unites with more oxygen from the air, and burns into carbonic acid gas CO_2. The chemical reaction is as follows: $SiO_2+3\,C=SiC+2\,CO$. The carbide of silicon SiC or carborundum forms a small mass of thin crystals having beautiful colors. These are crushed and made into various shapes for abrasives.

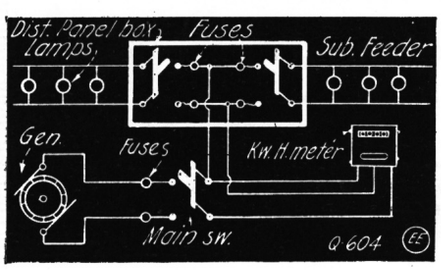
Q. 2. What is a "bug" cut-out?

A. 2. Bug cut-outs are small single pole cut-outs for placing in cramped and awkward places, such as in electric lighting fixtures where a regular fuse block cannot be used. Their use is practically prohibited to-day.

ELECTRIC WIRING.

(604.) Paul Zender, Hoboken, N.J., asks:

Q. 1. How should the distributing centers or cut-out cabinets be located?



Showing Usual Arrangement of Panel Board in House Wiring Layout for Light.

A. 1. They should be installed near a partition that is so located as to make the running of rises easy, and should be on an inside wall to guard against dampness.

Q. 2. What provisions should be made in wiring a hallway?

A. 2. The switching arrangements should be so designed that the lights may be turned on from the hall and the floor below or above.

Q. 3. What wiring system should be used with private plants?

A. 3. The two-wire multiple circuit system. A schematic diagram is illustrated here.

MEASURING INSTRUMENTS.

(605.) I. Straus, Schenectady, N.Y., wants to know:

Q. 1. What is a bolometer?

A. 1. A common form of bolometer consists of two similar circuits containing conductors of a material whose resistance changes rapidly with changes of temperature. These are arranged so that one may be exposed to the source of heat under investigation, while the other is protected from it. The two currents are connected respectively to the two coils of a differential galvanometer, which are wound or connected oppositely, so that the needle is only affected by the *difference* between the currents flow through the two coils. When both circuits are connected to the same battery and both are at the same temperature, equal currents flow through the two coils and the needle is not affected. But if the temperature of one is different from that of the other, then the resistances vary and the currents no longer balance, thus causing a deflection of the needle. Such instruments have been made so sensitive as to be affected by the heat from a candle several miles distant, and even measure the heat from distant stars. (See January, 1916, issue of THE ELECTRICAL EXPERIMENTER—"Measuring the Heat of Distant Stars.")

THE subscription price of this publication will be raised from $1.00 to $1.50 in a very short time. See our announcement in the July issue. If you wish to save money, now is the time to subscribe at the old rate: $1.00 a year, $2.00 two years, etc., and $5.00 for five years. (Foreign and Canadian add $0.50 per year for postage.) If you are a subscriber you will profit by extending your subscription for one or more years. No subscriptions accepted for a longer period than five years. ACT NOW, before this chance is gone.

RADIO QUERIES.

(606.) P. Langman, Seattle, Wash., writes:

Q. 1. What is the natural wave length of my aerial, composed of four wires 175 feet long, elevated 100 feet from the ground? The wires are separated from each other by a distance of 2 feet.

A. 1. The natural wave length of your antenna is 530 meters.

Q. 2. What is the advantage of a loose coupler over a tuning coil?

A. 2. Sharper tuning is obtained with the use of an inductively coupled tuner.

Q. 3. What is the formula for obtaining the frequency generated by a Poulsen arc?

A. 3. The formula is:—

$$F=\frac{5.033\times 10^6}{\sqrt{\text{Cap. M.F.}\times\text{Ind. Cms.}}};$$

where: F is frequency of oscillations in cycles per second.

FARADAY'S PRINCIPLE.

(607.) I. Bonehard, Montreal, Canada, wishes to know:

Q. 1. What is Faraday's principle of electromagnetic induction?

A. 1. When a conducting circuit is moved in a magnetic field so as to alter the number of lines of force passing through it, a current is induced therein, in a direction at right angles to the direction of the motion, and at right angles also to the direction of the lines of force, and to the right of the lines of force as viewed from the point from which the motion originated.

Q. 2. Explain just what happens when a current is induced by electromagnetic induction.

A. 2. In order to induce an electromotive force by moving a conductor across a uniform magnetic field, it is necessary that the conductor in its motion, should so cut the magnetic lines as to alter the number of lines of force that pass through the circuit of which the moving conductor forms a part.

Q. 3. What is the proper name for a conductor which moves across the magnetic field?

A. 3. An *inductor*, because it is that part of the electric circuit, in which induction takes place.

ELECTRICAL UNITS DEFINED.

(608.) Paul Jerome, St. Louis, Mo., inquires:

Q. 1. What is the International ampere and henry?

A. 1. The International unit of electrical current is the ampere, which is one-tenth of the unit of current of the centimeter-gram-second system of electromagnetic units, and is the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water, in accordance with standard specifications deposits silver at the rate of .001118 gram per second.

The unit of induction is called the henry, which is the induction in a circuit when the electromotive force induced in the circuit is one International volt, while the inducing current varies at the rate of 1 ampere per second.

Q. 2. What proportion of the total current is usually taken by the fields of shunt dynamos and motors.

A. 2. It varies from 30% or more in small machines to 1% or less in large machines.

STORAGE BATTERY QUERIES.

(609.) H. Russmore, Brookline, Mass., wishes:

Q. 1. What indicates the completion of a charge in a storage battery?

A. 1. When a cell is fully charged, the electrolyte apparently "boils" and gives off gas freely. The completion of a charge may be determined by the voltmeter which will show whether the normal pressure has been attained. Each cell will then show 2.5 volts.

Q. 2. How is the cadmium test made?

A. 2. A small plate or rod of cadmium is mounted in a hard rubber frame or tube and immersed in the electrolyte. The test consists of taking voltage readings, between the cadmium electrode and the positive or negative plate of the cell. During the charge the cadmium electrode reads negative to the negative plate until the cell is about fully charged, when the reading should be zero. The charge should be continued until the cadmium reads .2 volt positive to the negative while charging at normal rate.

Q. 3. How often should a battery be charged?

A. 3. At least twice a month, even if the use be only slight in proportion to the output capacity.

TESTING RESISTANCE.

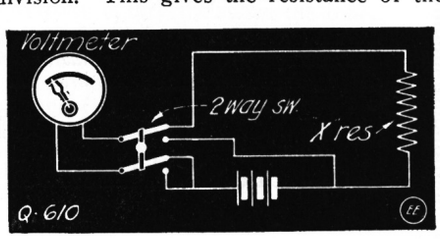
(610.) J. Yates, Baltimore, Md., wishes:

Q. 1. Diagram of connection of the voltmeter method of measuring resistance.

A. 1. The diagram gives the hook-up of the instruments.

Q. 2. How is the method used?

A. 2. Knowing the resistance of the voltmeter, turn switch downward, and from the reading calculate the current corresponding to one division of the scale. Turn the switch upward, multiply reading by current required for deflection of one division. This gives the resistance of the

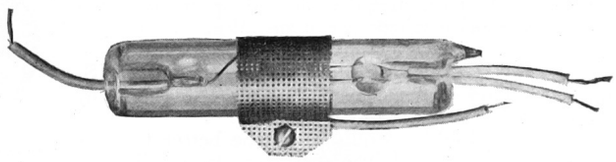


Method of Hooking Up Voltmeter to be Used in Measuring Value of Resistance.

voltmeter and unknown resistance. By substracting from the resistance of the voltmeter gives value of the unknown resistance.

(*Continued on page 356*)

The Moorhead Tube



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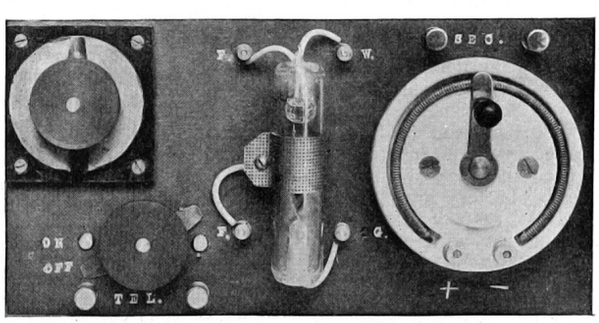

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Q. 3. In testing cable insulation, what is desirable with respect to voltmeter and current?

A. 3 A low reading voltmeter should be used in connection with a large battery.

COMPOUND DYNAMO.

(611.) F. Pierson, Sitka, Alaska, asks:

Q. 1. What is the difference between a compound and an over-compounded dynamo?

A. 1. In the first instance there are just enough turns in the series or compound winding to maintain the voltage constant at the brushes for variable load. If a greater number of turns are used in the series winding than is required for constant voltage at the brushes for all loads, the voltage will rise as the load is increased. This makes up for the loss or drop in the transmission line, so that a constant voltage will be maintained at some distant point from the generator. The machine is then said to be over-compounded.

Q. 2. For what service is over-compounding desirable?

A. 2. For incandescent lighting where there is considerable length of transmission lines.

Q. 3. For what service is the series dynamo adapted?

A. 3. It may be used for series arc lighting as a booster for increasing the pressure on a feeder carrying current furnished by some other generator.

ULTRA-AUDION.

(612.) P. Donovan, London, England, wants:

Q. 1. A connection for an Ultra-Audion?

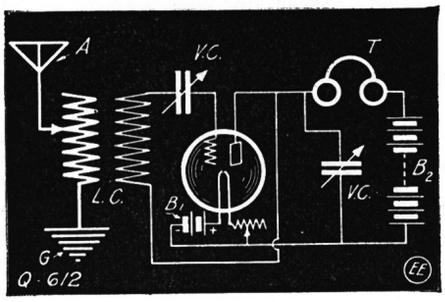
A. 1. The diagram herewith shows the connections.

Q. 2. What crystal detector do you consider the best in connection with a single step Audion amplifier?

A. 2. Practically any of the well-known crystal detectors can be used.

Q. 3. Should the illumination intensities of filaments of a two step amplifier be similar?

A. 3. The intensity of the first filament should be lower than the second. This can be determined by experiment as different Audions have different characteristics. It is therefore difficult to state off-hand how they should be controlled.



Hook-Up for Ultra-Audion.

DETECTORS.

(613.) Louis H. Printz, Waynesville, Ohio, writes for:

Q. 1. Some information on radio transmission without towers, as described in an article in the July, 1916, ELECTRICAL EXPERIMENTER.

A. 1. When no towers are used, a common ground aerial system is employed which is nothing more or less than a wire stretched several feet above the ground or in some cases on the ground.

Q. 2. I would like to learn the nature of the Tel-Radion detector and the Crystaloi?

A. 2. As regards the first detector we do not know its nature and construction details. However, we would suggest that you write the company who manufactures same, the address of which can be obtained from our advertising columns. The Crystaloi consists of a sensitive galena detector from which several contacts are obtained on its surface by means of a large number of certain metallic filings, which are placed in the same receptacle. The connections are made from the crystal and from an opposite plate which touch the filings.

RADIO RECEIVER CONNECTIONS.

(614.) George M. Gilber, Binghamton, N.Y., says:

Q. 1. Why would it not be better to connect a pair of head receivers in parallel instead of series? For instance, two receivers have 1,000 ohm resistance each, and contain 1,000 turns of wire each; .001 volt is passing through them they are series-connected. .001 volt divided by 2,000 ohms equals .0000005 ampere and .0000005 ampere multiplied by 2,000 turns would be .001 ampere-turns. If they were parallel-connected there would be 1,000 turns and only 500 ohms resistance, and if .001 volt was passing there would be .001 volt divided by 500 ohms, which equals .000002 ampere and .000002 ampere times 1,000 turns would be .002 ampere-turns against the .001 ampere-turns of the series connected phones. As it is ampere-turns that we are after and not ohms, I should think it would be better to connect them in parallel.

A. 1. You are correct in theory, but in actual practice radio receivers are invariably connected in series for the reason that there is usually about enough current to satisfy the ampere carrying capacity of a single receiver.

RADIOSON DETECTOR.

(615.) Elmore Slade, New Canaan, Conn., asks:

Q. 1. Is the Radioson detector a good one for portable sets? Has it any serious defects in this use?

A. 1. The Radioson detector is an excellent one for portable sets and it has no serious defects. However, it should be protected from breakage when carrying the portable set.

Q. 2. Can a Radioson detector be used in place of an ordinary electrolytic detector in the hook-up which I submit?

A. 2. The connections are correct and you should not have any trouble in obtaining satisfactory results with this arrangement.

AUDION CURRENT.

(616.) Sanford P. Bordeau, Gilbert, Minn., inquires:

Q. 1. Can the direct current of 80 volts, 4 amperes, developed by an alternating current rectifier be used in place of the flash-light cells of the "B" battery and the storage battery of the "A" battery of an Audion when used in series with proper resistance?

A. 1. We are very doubtful if you can use the direct current obtained from a rectifier for the high potential current, as the current obtained from such a device is somewhat pulsating and not truly direct.

Q. 2. Is the exhaustion of an Audion bulb necessary for it to rectify or simply to prevent the oxidation of the filament?

A. 2. The exhaustion of an Audion bulb is necessary in order to obtain rectification, and also to prevent the oxidation of the filament when lighted.

Q. 3. What is the wiring plan for obtaining one turn at a time, with two switches, used in nearly all commercial Navy type transformers?

A. 3. We suggest that you refer to the September, 1915, issue of THE ELECTRICAL EXPERIMENTER for obtaining the necessary information regarding the connection of a Navy type loose coupler. Full construction details were given there.

INDUCTIVE CAPACITY.

(617.) J. Logan, Brooklyn, N.Y., wants to know:

Q. 1. What is specific inductive capacity?

A. 1. Specific inductive capacity is the quality of the dielectric which enables it to hold an electric charge between two conductors. Air is taken as a standard, its specific inductive capacity being equal to unity or 1. When two conductors such as two parallel plates are connected to the opposite terminals of a battery or other source of potential difference, the quantity of electricity that flows in or out of the condenser depends upon the nature of the substance between the plates. Thus, if two plates were separated at a given distance by glass the combination would constitute a condenser of about three times what the capacity would be with simple air between the plates; hence the specific inductive capacity of glass is about three.

Q. 2. What causes the humming of telegraph and telephone wires?

A. 2. This is principally due to the mechanical vibration caused by the wind; these vibrations often travel along the wires for miles.

DO YOU

own a wireless station, either for sending or receiving? If you do, don't fail to join the greatest Wireless Association in the country: THE RADIO LEAGUE OF AMERICA. If you believe in the preparedness of your country, if you wish to help Uncle Sam, if you wish to have your station officially recognized, join the LEAGUE, a national, non-money-making organization. Beautiful engraved and sealed certificate, FREE to all members. NO DUES OR FEES WHATSOEVER.

Honorary Members: W. H. G. BULLARD, U. S. N.; PROF. REGINALD A. FESSENDEN; DR. LEE DE FOREST; DR. NICOLA TESLA.

Send stamp for large 8-page information booklet.

DO IT NOW. 233 Fulton St., New York City, N. Y.

THE AURORA BOREALIS.

(618.) M. Klickburg, Hempstead, L.I., asks:

Q. 1. Does the Aurora in nature have anything to do with electricity?

A. 1. Auroral displays are connected with magnetic storms. The exact cause is not certain, but it is believed to be electrical discharges occurring in the upper atmosphere in consequence of the differing electrical conductions between the cold air of the polar regions and the warmer streams of air in vapor, raised from the level of the ocean in tropical regions, caused by the heat of the sun. We would refer you to the October, 1915, issue of THE ELECTRICAL EXPERIMENTER for valuable information on this interesting subject.

Q. 2. Is the "per cent drop" calculated from the voltage at the dynamo, or that at the lamps?

A. 2. It is commonly calculated from the volts at the lamps, but ordinarily it does not make sufficient difference to change the size wire a single number, so that either voltage may be ordinarily taken as the base.

LAMP QUERIES.

(619.) N. Vandale, Manila, Cuba, asks:

Q. 1. Why is the upper carbon of an arc lamp positive?

A. 1. The positive carbon has a crater which is very hot and emits a major part of the light from the arc. This light from the crater is in a downward direction, if the upper carbon is the positive pole. It thus avoids the use of reflectors or diffusers with the increased cost and lower efficiency.

Q. 2. Why are springs used on the arma-

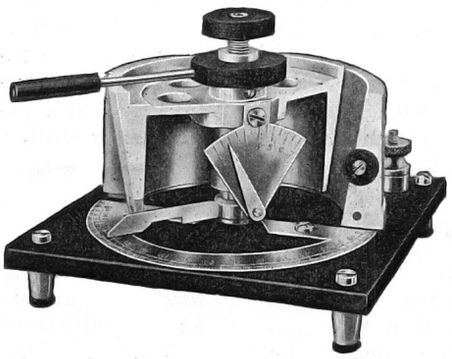
(Continued on page 360)

TURNEY TURNEY

The New Turney Vario Variable Condenser Has Seven Scales

10 Days' Trial Allowed

The new TURNEY VARIO VARIABLE CONDENSER is a real innovation in variables. It is seven complete Condensers in one, has seven different scales all of different maximum capacities and approaches an absolute zero heretofore unknown in Condensers. There are no plates to warp, therefore the instrument remains constant. The movable and stationary members are made of a special alloy which in appearance resembles silver and will not tarnish.



DIMENSIONS 6"x6"x3" SHIPPING WEIGHT 2 LBS.

SCALE READINGS

Scale No. 1-0 to .001 M.F. Scale No. 4-0 to .00012 M.F.
Scale No. 2-0 to .0005 " Scale No. 5-0 to .00007 "
Scale No. 3-0 to .00025 " Scale No. 6-0 to .000055 "
Scale No. 7-0 to .000035 M.F.

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The new TURNEY VARIO VARIABLE CONDENSER is ideal for EXTREME MEASUREMENTS where absolute accuracy is demanded. It is incomparable for WAVE METERS and Regenerative Ionized Gas and pure Electron Detector circuits. The entire instrument (with the exception of the base which is of Bakelite) is engine turned and is made with the greatest care.

Don't buy a Condenser until you have seen the TURNEY VARIO VARIABLE.

EUGENE T. TURNEY CO., Inc., 2595 Third Ave., New York City

The New Turney Head Set With Adjustable Pressure Head Band

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This new head set is the last word in Wireless HEAD SETS. They have a total resistance of 3000 Ohms, weighs only 9 OZ. There is but one screw in the entire set and that is on the top of the HEAD BAND. All adjustments are instantaneous while in position on the head. The ear cups which contain the magnets are of a light weight alloy, 1¾"x¾", which is very small and look like satin silver. They are machine finished, which gives them a handsome appearance. They are perfectly matched and the diaphragms are resonance tuned.

Price $7.50

SHIPPING WEIGHT 1 LB. POSTAGE EXTRA

10 Days' Trial Allowed

This new Patented head band with its pressure adjustment is the most valuable accessory to a head band that has ever been produced. It makes it possible for the operator to have absolute comfort no matter how long he has to wear it. The exact pressure desired is produced by simply turning the screw while on the head. The ear caps are of pure Bakelite and fit the ear perfectly. These phones are extremely sensitive and if they are not the best in every particular of any head set you ever saw or tried, about fifty wireless experts here in New York are all wrong.

TURNEY TURNEY

Radiocite

"USE RADIOCITE IN YOUR DETECTOR AND FORGET IT"

RADIOCITE is the most wonderful of all radio crystals. It is more sensitive than Galena and far more sensitive than ANY other crystal or mineral. RADIOCITE is a specially selected grade of a rare crystal chemically treated by our own secret process.

The mineral that looks like liquid gold. It has a highly, wonderfully polished surface giving it a perfectly burnished appearance. This crystal is now in use by several governments, and is conceded to be the most satisfactory of all. It is used with a medium stiff phosphor bronze spring, or with a stiff silver wire, about No. 30 B. & S. Gauge.

One of the important features of RADIOCITE is that it does not jar out easily. Each crystal is *tested for sensitivity* and guaranteed. RADIOCITE comes packed separately in a box, wrapped in tin-foil. Full directions accompany it.

WHAT IT IS

RADIOCITE can be mounted like any other crystal; it may be clamped between springs, but it is best to set it in *Hugonium* soft metal. Money refunded if our claims are not substantiated.

No. 3939. Generous piece of tested RADIOCITE. **Prepaid, $0.50.**

THE ONE UP-TO-DATE MINERAL WHICH EVERY AMATEUR MUST HAVE

WHAT THEY SAY:

The letters which we publish herewith tell our story far better than we could. Hundreds of enthusiastic testimonials fill our files Read and see what these well-known amateurs from all parts of the country say. Can you afford to be without RADIOCITE?

E. I. Co., N. Y. Lanark, Ill.

My dear Sirs:

Regarding your new detector crystal *Radiocite* wish to advise that I have received the crystal.

I have used and given same a careful test and *am surprised* at the results received with it. I really consider it a better grade of crystal *than any Galena I ever tried.* Although my station includes an Audion Detector, *I much prefer the Radiocite* for amateur work, for it is very easy to keep adjusted; NAA comes clear as a bell. I will be glad to recommend your crystal to anyone.

Yours very truly,
E. H. GIDDINGS
Radio Station 9MK., Lanark, Ill.
Telegraph Operator, C. M. & St. P. Ry.

The E. I. Co., Owego, N. Y.
New York, N. Y.

Gentlemen:

I have thoroughly tested your, *Radiocite*, and find it very stable *withstanding very severe static* and holding a very sensitive adjustment for several days without touching on a table subjected to considerable jarring. Another detector setting beside it would not hold its adjustment but for a short time. It is easy to adjust, and of the several kinds of minerals used by me I consider it the most sensitive. I would recommend *Radiocite* to all amateurs and others who desire a detector easily adjusted, very sensitive, and one which will hold its *adjustment indefinitely and stay sensitive.*

Yours respectfully,
H. G. SMITH.

E. I. Co., N. Y. Littleton, Mass.

Dear Sirs:

That *Radiocite* crystal is one of the best I have used. The first time I tried it stations came in great, some I had never heard before. I hear N.A.A. so loud that I can lay the phones on the desk and hear them. Very truly yours, JACK HARDY

St. Paul's M.E. Parsonage,
E. I. Co., N. Y. Penn's Grove, N. J.

Dear Sirs:

I received my *Radiocite* O. K. and have had splendid results with it. It brought in signals clearer than *Galena* or other minerals I have used. I think it will please everybody.

WM. OGBURN LYNCH

E. I. Co., N. Y. Le Roy, N. Y.

Dear Sirs: June 21st

I have thoroughly tested the *Radiocite* which I received from you and find it far superior in all respects to *Galena, Silicon* or any other mineral I have ever used.

Respectfully yours,
WM. N. TOWNER

E. I. Co., N. Y. 729 Euclid Ave.,
Dear Sirs: Baltimore, Md.

I could not express my satisfaction with the new mineral *Radiocite. It is more sensitive than any crystal detector* I have ever tried. It is also permanently sensitive and *is not knocked out by the ½ K.W. open core transformer* which I use for sending. I remain your true friend,
W. J. POHLMAN

404 Mt. Prospect Ave.,
E. I. Co., N. Y. Newark, N. J.

My dear Sirs:

I received your tested *Radiocite* and find it excellent. As soon as I received it, I put it in the cup, put the detector spring on and N.A.H. came in so loud he could be read *sixteen feet from the phones.*

Yours truly, HENRY D. WILSON, JR.

Electro Importing Co.,
236 Fulton Street, New York City.

On your absolute guarantee that RADIOCITE is exactly as described by you, I enclose herewith 50 cents in .....for which you are to send me *prepaid* one box containing a generous piece of *tested Radiocite.* You accept my money with the understanding that you will refund it to me at once, should I find the RADIOCITE unsatisfactory. *You guarantee to ship within twenty-four hours or return my remittance.*

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Selenium Cells

MADE IN AMERICA

FOR eleven years we have been the largest distributors of selenium cells in the world. We have actually sold more such cells than all other houses combined.

Before the European War broke out we had been selling the well-known Gripenberg cell exclusively, but inasmuch as this cell is an imported one, we have not been able to secure it for nearly a year.

We now present for the first time in history a wonderful American-made Selenium Cell, much more efficient than ANY cell ever handled by us. It will rank high in electrical circles as it has several valuable points not usually found in such cells. We unhesitatingly recommend it and stand back of all our claims.

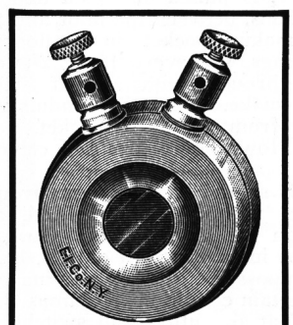

ILLUSTRATION IS FULL SIZE

Our illustration shows the full size of the cell. It is built in form of a watch and is entirely foolproof. There are no screws, no loose wires—nothing to get out of order. The over-all size is 1½"x1¼". The selenium surface is protected by glass and can therefore not be injured, even if roughly handled. The active selenium surface measures ⅜" in diameter—a very large surface and much larger than found in the best cells. The current is supplied to the cell by means of two neat binding posts. The metal case is nickel-plated.

The ratio of these cells is remarkable. Thus a typical cell in the dark measures 96,000 ohms, while if exposed to a 40 c. p. tungsten lamp, the resistance drops to 12,000 ohms. This is a ratio of 8 to 1 which is remarkable and bespeaks of the high quality of the construction. Every cell is guaranteed and we will replace any not giving satisfaction.

IMPORTANT. When ordering state if you wish a high resistance or a low resistance cell.

WE HAVE A LARGE SUPPLY ON HAND. IMMEDIATE SHIPMENTS. ORDERS FILLED WITHIN 24 HOURS.

No. 517 Selenium Cell as described each **$5.00**
By Registered Mail extra $0.12

No. 715 Built-up Selenium Cell (1 Million ohms. Ratio of 30 to 1. Works on 110 Volts) Price each **$7.00**

No. 716 Special Vacuum Selenium Cell. (Resistance can be had from 5,000 to 500,000 ohms.) Price **$10.00**

We Are Sole Distributors of These Cells.

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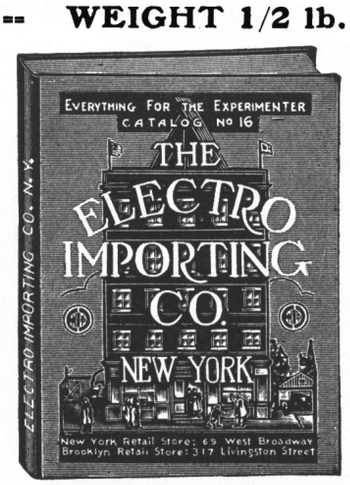

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How to Receive Time by Wireless.
How to Photograph Electrical Discharges.
How to Experiment with Spark Coils.
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Gentlemen:
Enclosed please find eighty-five cents for which please send me one Constant Amplitude Test Buzzer. I have been using your type O Crystaloi all summer and have received NAA and NAR through static that ties up all other types of detector.

Very respectfully,
BAYARD SHUMATE.

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"ASTRALE" FLUORESCENT X-RAY SCREENS

By our new process the fluorescent salts are deposited directly on heavy celluloid making the screen dust and water proof as well as mechanically strong.

Do not use old style paper screens easily punctured and which deteriorate in time.

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Standard Sizes Complete Screens in Frame
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Experimenters! ATTENTION!

Make your own generator or alternator. We can furnish you with finished or unfinished parts for machines from 80 to 800 watts output. Free instructions to wind with every order. Any size transformer made to order.

AT FACTORY PRICES!

All kinds electrical repairing, commutators refilled a specialty. Satisfaction guaranteed.

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BERGMANN MOTOR WORKS
442-446 Niagara Street, Buffalo, N. Y.

There's a Book You Need on Page 378. LOOK FOR IT

QUESTION BOX.

(*Continued from page 356*)

ture or alternating current arc lamps and not on direct current ones?

A. 2. With alternating current there is a tendency for the action of the armature to be jerky or unsteady, and cause the light to flicker. By the insertion of these springs, the vibration of the armature is absorbed, so to speak, instead of being transmitted to the upper carbon, causing both the action of the lamp and the light to be more steady. This jerky feature is absent in the direct current lamps, in which no springs are necessary.

CONDUIT WIRING.

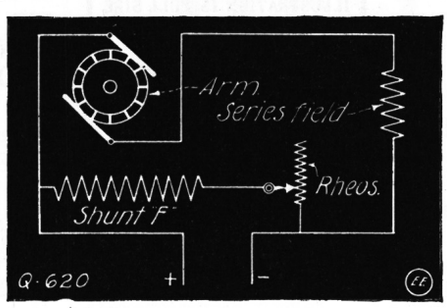
(620.) O. Blassland, Newark, N.J., writes:

Q. 1. How is a flexible conduit installed by "fishing?"

A. 1. It is pulled or fished under floors in partitions, between the floor and the ceiling, by making pockets in the floors, walls, and ceilings, say every 15 or 20 feet, and fishing through with a stiff steel wire called a snake. Thus the conduit is pulled in place from pocket to pocket.

Q. 2. How should armored cable be installed?

A. 2. It should be continuous from outlet to outlet without being spliced, and installed on the loop system. Outlet boxes should be installed at all outlets, but where this is impossible, outlet plates may be used under certain conditions. Clamps should be provided at all outlets and switch boxes to hold the cable in place, and also to serve as a means of grounding the steel sheathing.



A Rheostat to Control the Speed of a Compound Dynamo is Connected According to This Diagram

Q. 3. Give diagram of connection of a compound dynamo with a rheostat for regulating the current through the shunt winding.

A. 3. The diagram gives the proper connections.

COST OF EXPERIMENTAL LABORATORY.

(621.) Nick Smucyn, Chicago, Ill., wants:

Q. 1. An idea of the cost of an experimental laboratory for chemical and electrical research?

A. 1. You will find some good ideas given relative to a chemical laboratory and the cost of it in the *Experimental Chemistry Course* which started in the June, 1916, issue of THE ELECTRICAL EXPERIMENTER. The cost of an electrical laboratory ranges from a few dollars up to thousands of dollars. It all depends, of course, on what kind of work and its magnitude which you wish to perform in the laboratory.

Usually, if you purchase a fairly accurate voltmeter and ammeter, together with a few ordinary incidentals, you can undertake some worthwhile experiments. A Wheatstone bridge or Ohmmeter will be found very useful in any electrical measurements and tests. A small electric furnace is useful for some work as well as several rheostats, inductances, or impedance coils.

RADIO INTERFERENCE TROUBLE.

(622.) A. B. Rowland, Stuttgart, Ark., asks several antenna queries:

A. In the first place we do not know just exactly the location and arrangement of your antenna. In general, it has been our experience that a simple antenna consisting of but two wires, elevated 40 to 50 feet above the ground, having a length of 250 to 300 feet or more, will do excellent work, especially in receiving.

Again, the antenna should, in all cases, be placed at right angles to all transmission lines carrying commercial light and power currents. If this is not watched carefully there will be observed considerable induction from the antenna with severe interference created by the low frequency alternating currents on the transmission lines. In some cases this effect is so marked that it will entirely drown the signals in the receivers, unless the signals are particularly strong.

A method which has been used successfully to reduce such interference from nearby commercial light and power circuits consists of shunting a very small condenser across the antenna and ground connections before they enter the loose coupler or tuning coil. This condenser is composed of a few small sheets of tin foil, separated by paraffined leaves, the size of the foil sheet being about ¾x1 in. About 10 leaves may be tried, and a greater or less number used, as experience with this arrangement dictates. The size of the condensers will vary of course for different conditions.

With respect to your antenna and the wire for it, we would suggest that all the joints be well made and soldered, for any corrosion on the joint will tend to yield poor results. We advise that you look over some of the complex interference preventer diagrams given in the excellent 25c. book entitled "Wireless Hook-ups" obtainable from our Book Department. Undoubtedly the Marconi or Fessenden arrangement for this purpose will help you. The book mentioned explains both of these connections. Usually the proper arrangement of variable condensers and tuning inductances will eliminate, to a large extent, the sort of interference which seems to trouble you.

BRAUN TUBE REPAIRS.

(623.) Mr. Ralph Batcher, Ames, Iowa, wants to know:

Q. 1. Where he can have a Braun tube repaired?

A. 1. We are glad to know that you appreciated the articles published in a recent issue of THE ELECTRICAL EXPERIMENTER on the Braun cathode-ray tube by Prof. Dr. Ferdinand Braun. The Electro Importing Co. of New York will undoubtedly be able to have the repair made for you if the tube can be repaired at all.

NEW ALUMINUM SOLDER.

A new form of aluminum solder to be applied with a flux has been invented by Mr. Frederick W. Beitz of Peoria, Ill. This solder may be used with a soldering copper and the solder itself contains no aluminum, the inventor claims. Such solders have extensive applications nowadays and prove particularly effective for experimenters' requirements, as it is not always desirable to rivet or otherwise join aluminum parts making up tanks, cylinders and other parts.

STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

74. *Inductance, Effective of an Antenna:* See Capacity, Effective of an Antenna.
75. *Impulse Excitation:* See Excitation, Impulse.
76. *Interference, Wave (In Radio Communication):* The reinforcement or neutralization of waves arriving at a receiving point along different paths from a given sending station; (to be distinguished from ordinary or station interference, which is the simultaneous reception of signals from two or more stations).
77. *Key:* A switch arranged for rapidity of manual operation and normally used to form the code signals of a radiogram.
78. *Key, Relay:* See Relay Key.
79. *Length, Wave:* See Wave Length.
80. *Losses, Brush or Corona:* See Brush or Corona Losses.
81. *Meter, Wave:* See Wave Meter.
82. *Oscillations (In radio work):* See Current, Damped Alternating.
83. *Oscillator, Arc:* See Arc Oscillator.
84. *Potentiometer:* As commonly used for radio receiving apparatus, a device for securing a variable potential by utilizing the voltage drop across the variable portion of a current carrying resistance.
85. *Radiation, Sustained:* See Waves, Sustained.
86. *Radiogram:* A telegram sent by radio.
87. *To Radiograph (verb):* To send a radiogram.
88. *Radio Telephone:* An apparatus for the transmission of speech by radio.
89. *Radiophone (noun):* A telephone message sent by radio.
90. *To Radiophone (verb):* To send a radiophone.
91. *Rectifier, Electron:* A device for rectifying an alternating current by utilizing the approximately unilateral conductivity between a hot cathode and a relatively cold anode in so high a vacuum that a pure electron current flows between the electrodes.
92. *Rectifier, Gas:* An electron rectifier containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.
93. *Relay, Electron:* A device provided with means for modifying the pure electron current flowing between a hot cathode and a relatively cold anode placed in as nearly as possible a perfect vacuum.
    These means may be, for example, an electric control of the pure electron current by variation of the potential of a grid interposed between the cathode and the anode.
94. *Relay, Gas:* An electron relay containing gas which modifies the internal action by the retardation of the electrons or the ionization of the gas atoms.
95. *Relay Key:* An electrically operated key. See further, Key.
96. *Resistance, Antenna:* See Antenna Resistance.
97. *Resistance, Critical, of a Circuit:* That resistance which determines the limiting condition at which the oscillatory discharge of a circuit passes into an aperiodic discharge.
98. *Resistance, Effective, of a Spark:* The ratio of the power dissipated by the spark to the mean square current.
99. *Resistance, Radiation:* This is the ratio of the total energy radiated (per second) by the antenna to the square of the R. M. S. current at a potential node (generally the ground connection). See further, Antenna Resistance.
100. *Resistance, Radio Frequency:* This is the ratio of the heat produced per second in watts to the square of the R. M. S. current (r f.) in amperes in a conductor.
101. *Resonance:* Resonance of a circuit to a given exciting alternating E. M. F. is that condition due to variation of the inductance or capacity in which the resulting effective current (or voltage) in that circuit is a maximum.
    Note 1: Instead of varying the inductance and capacity of a circuit the frequency of the exciting field may be varied. The condition of resonance is determined by the frequency at which the current (or voltage) is a maximum.
    Note 2: The resonance frequency corresponds the more accurately to the frequency of the free oscillations of a circuit, the lower the damping of the exciting alternating field and of the excited circuit.
102. *Resonance, Acoustic Device:* See Device, Acoustic Resonance.
103. *Resonance, Sharpness of:* See Tuning, Sharpness of.

(To be continued)

The Best 1 K.W. Transformer *Ever Designed*

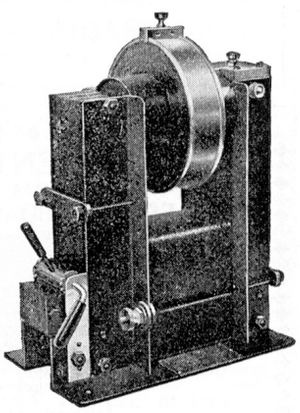
IT'S a THORDARSON, of course—a new type, with wonderful range and flexibility.

Radio League experts who have seen this new THORDARSON predict a tremendous demand. It is a remarkable transformer. THORDARSONS have always been noted for unusual results. But this new THORDARSON is *fully 100% better.*

THE NEW THORDARSON

WIRELESS TRANSFORMER

will enable you to send farther, will tune up more easily, quickly and accurately, and give even more satisfactory service than the previous model. Every feature of its design has been refined and perfected. The variable shunt—an exclusive THORDARSON device for attaining perfect resonance at any range—has been radically improved. Moreover, it is now equipped with an Ampere Scale, enabling the operator to know just how much current is being used and radiated.



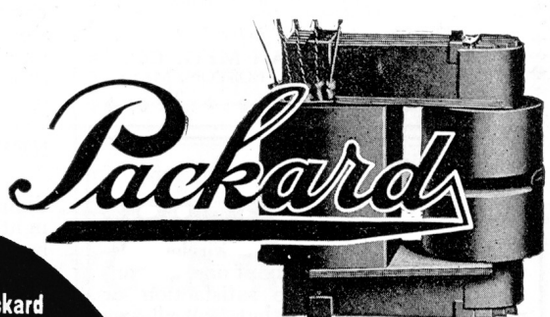
The new THORDARSON is very strongly built, of pressed steel, without a single casting—nothing to break or get out of order. Is more portable, weighing 20 pounds less than the former model. So compactly designed as to be really handsome in appearance.

Every operator who wants efficiency in this transformer should own a THORDARSON, particularly the 1 kw. size. Made in 5 sizes, ranging from ½ to 2½ kw., 10,000—20,000 volts, any cycle desired.

Write today for full details and prices

Made by the Builders of the 1,000,000 Volt Transformer at the San Francisco Fair

Thordarson Electric Mfg. Co., 506 SO. JEFFERSON STREET CHICAGO, ILL.



"I Have Transmitted Over 700 Miles with a Packard Transformer"

says amateur operator 9 K U.

The reason is that Packard Transformers produce maximum power from small condensers.

Let us tell you how you can do part of the work yourself and get this excellent transformer at a remarkably low cost.

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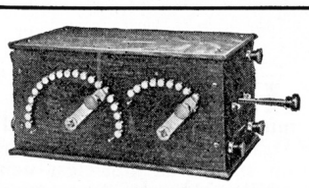
THE PACKARD ELECTRIC CO.

WARREN, OHIO



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"Your new tuner with switches works just fine. Even in middle of summer I hear lots of stations with your tuner, but with other tuners I get just a few." Henry Wheat, Jr., Geneva, N. Y. Fall term of school begins August 28. Send 2-cent stamp for bulletins.

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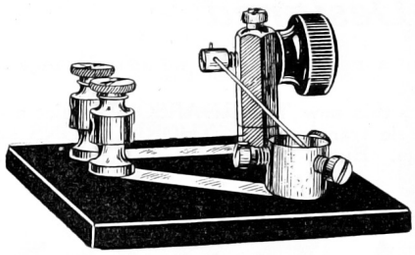

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No more soldered catwhiskers! Special quick action wire chuck works on same principle as the Binding posts. *Insert wire, turn knob.*

Price includes 3 catwhiskers of phosphor bronze. Same material used for connecting strips. Polished base of vulcanized black fibre. Brass parts gold lacquered. Nickel plated, 25c. extra.

BRONX RADIO SUPPLY CO.
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EXPERIMENTERS!!

WE SPECIALIZE IN

SEAMLESS CARDBOARD TUBING

IN SIZES SUITABLE FOR

TUNING COILS, LOOSE COUPLERS, TESLA COILS, Etc.

SPECIAL GRAY TUBES

18"x6½"x6⅞" .75ea. 18"x7½"x7⅞" .75ea.

PRICE LIST

Smooth Wound Wireless Tubes

Outside Diam.	Lgth.	Price	Par. Post
3	x 7½	.10	.16
3½	x 7½	.10	.16
4	x 7½	.15	.22
4½	x 7½	.15	.22
5	x 7½	.20	.26
5½	x 7½	.20	.26
6	x 7½	.25	.32

GENERAL INFORMATION

These prices include PARCEL POST CHARGES: and are shipped at once on receipt of order and remittance.

We CANNOT furnish these tubes in longer lengths than 7½" unless ordered in quantities of 100 of a size.

We CAN furnish SPIRAL WOUND TUBES in any length up to 45 inches at .02 per inch in the following diameters, 3½-4-4½-5-6.

Send 2c. stamp for Price List

BEETLE & MACLEAN MFG. CO.
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BOYS

Stop! Look! Listen!

Just think of having four wireless detectors in one for the price of one, guaranteed to give absolute satisfaction or money refunded. And that isn't all—we will give you a whole month to pay for it. Price $5.00. Size over all 4x4x2. Write now for particulars, as we only have a limited supply.

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NOGALES -:- ARIZONA
P. O. BOX 132

DON'T HESITATE

About buying a radio set because of lack of ready money.

We will sell you any kind, style and price of set on easy terms, or you can open a charge account with us and buy as you need and pay for it at the end of the month. Write for particulars.

Radio Distributing Company
Lombard, Illinois

A PORTABLE HIGH FREQUENCY OUTFIT FOR THE FAMILY.

While most every day folks do not take kindly to electrical treatment at home, this phase of the subject reverses itself when one is introduced to the numerous merits and really worth-while results to be had from the application of mild high frequency currents. An apparatus known as the *Vi-rayette* has been put on the market for this home treatment of many ailments. It is put up in an extremely neat velvet-lined carrying case and includes a powerful high frequency transformer operating from any electric lighting socket, a surface-comb, external throat electrode, connecting cord and plug.

Practical High Frequency Outfit for Family Use.

The apparatus in question is capable of yielding excellent results in ordinary and chronic cases, particularly in the treatment of hardening of the arteries, or *arterio-sclerosis*. Many ordinary ills such as head-aches, tooth-aches, intestinal complaints, swollen glands, rheumatic stiffness, muscular fatigue or partial paralysis, et cetera can be very well treated by the patient in the privacy of his own home. It is surprising what beneficial effects will result from applying such a high frequency current for a few minutes daily. It does not breed a "habit" like many deadly patent medicines.

The editor, who was troubled with many abscesses in the ear last winter, found much comfort from one of these apparatus. An abscess which would ripen only in about a week would open in 24 hours when the high frequency current was employed several times a day.

NEW MOTOR-DRIVEN POLISHER.

The Omega High Speed Auto and Brass Sign Polisher here illustrated has a special light built, high speed motor, giving the buff the proper surface speed. It is, moreover, very light in weight making it extremely easily to handle.

The complete outfit is equipped with a 3½x½ grinding wheel, a steel brush wheel for cleaning tires before vulcanizing and two buffs for polishing brass or nickle plate, and has a threaded tapered spindle for attaching the various wheels.

This Motor-Driven Buffer Will Polish Up Your Brass Signs In a Jiffy.

The motors are universal, operating on either direct or alternating current, 25 or 60 cycle, 110-130 volts and other voltages are provided for when the purchaser so desires.

Wireless music has been furnished a company of travelers at sea. The next great invention should be musicless neighbors in flats. What?!!

THE MYSTERIES OF ULTRA-VIOLET LIGHT.

(*Continued from page 311*)

by aliniation with cross wires in the telescope and checked up the following day from the *Nautical Almanac* by laying off their orbits on a drawing board."

While the planet Saturn has nine moons, only four of these could be shown on our front cover. The other ones are so far away that they fall beyond the edges of the magazin The four moons are shown as white dots silhouetted against the sky.

Another family of the Ultra-Violet rays is the Infra-Red rays which have a longer wave length. Their velocity is considerably less in comparison with that of the ultra-violet. Although very little research work has been done with this subject, it may be of interest to the reader to see the effect of the Infra-Red rays on a photographic plate. Fig. 6 shows a group of trees in a park in Florence, Italy, taken by infra-red light.

As will be noted a curious result is obtained. The sky is pitch black while the trees are white. All shadows are black, however. This photograph was made with an ordinary glass lens but a color filter, absorbing all other rays, including the ultra-violet ones, was used.

ELECTRICITY, THE MYSTIC IN MODERN HOTEL SERVICE.

(*Continued from page 313*)

and the chief picks up pass keys opening any door in the hotel.

Besides the telephone system, this hotel has an electric thermostatic fire alarm working automatically in each room and corridor. These announce the fire and the point of incipiency to the Fire Captain. Again there are provided in all corridors square brass boxes containing a small illuminated electric bulb. On the bulb appears the notice "Break glass for Fire Department." A tiny hammer hangs beside it for the purpose. When the bulb is broken it causes an electric relay, with which it is in series, to operate fire alarm bells in the engine room and simultaneously reveals the number of the circuit, so that the exact location of the fire is known to the Fire Captain. More wonderful, still, is the fact that various sections of any floor can be quickly isolated or shut off so as to confine the conflagration by simply throwing in certain switches at the telephone switchboard. These control magnetic release hooks attached to certain doors throughout the building.

Other conveniences found in every room are of course the telephone, which may be used at once simply for house calls, connection with the Clerk, or for outside long-distance connections; electric reading lamps secured to each bed, night lamps of low candle-power for the use of those guests who prefer to sleep in a semi-dark room; electric fans, etc. Ice water is always available in these modern hotels without depending on that immortal, time-worn nuisance of punching a button three times and sometimes twenty-three before the thirst-quencher finally appears, in his right hand the ice water pitcher, in his left your awaiting dime! This ice water is filtered, softened and distributed by electrically operated machinery located in the basement and comes under the charge of the chief engineer.

Some hotels also have a number of refinements involving the use of electricity such as curling iron heaters, electrically heated pads which may be used for attacks of cold feet and back, and electrical shaving mug heaters.

As the fiction writers have it, the way to a man's heart is through his stomach. Acting on this suggestion, let us see how the Chef performs his wonders. The gastronomic seat of all hotel life is, of course, in the kitchen. Here it is that the famous French, Hungarian, Bulgarian (and don't forget the spaghetti experts) Italian Chefs hold forth in all their glory of Vandyke beards and white linen caps. Some idea of the enormous amount of help employed in up-to-date hotels may be gleaned from the fact that the Hotel Biltmore in New York City employs constantly about fourteen hundred people, which includes waiters, kitchen attachées, chambermaids, valets, bellboys, ad infinitum. Electricity is truly a wonderful genii in this department, from sawing apart a whole side of beef or a loin of chops, up to the motor-driven dish-washing machine which cares for the mountains of soiled dishes. In the preparation of the food many electrical machines, some of them specially designed, help the good work along, such as meat choppers, cutters and grinders, egg beaters and boilers, coffee grinders, cream whippers, dough mixers, ice cream freezers, ice crushers and cubers, silver plating, polishing and buffing machines, potato peelers, lemon squeezers and so on down the line. In many cases cooking is done either partially or entirely by electricity. This form of range is one of the latest, and has proved very satisfactory, as the heat may be regulated to a nicety with corresponding effect on the treated delicacies.

The method of handling the dining-room service is of paramount importance as might be supposed. At the Hotel Biltmore, for instance, there is an extremely efficient arrangement in use for this purpose. The main dining-rooms on the lower floor are in close proximity to the kitchens, so that the waiters may gather up their dishes directly. However, for the Roof Garden restaurant and individual room service, there is supplied a series of eight large dumbwaiters, which are the nearest approach to the human specimen that the author has ever come in contact with.

Suppose a waiter on one of the upper floors wishes to place an order for a certain dish or dishes in the kitchen below. All he does is to write out the order for the desired victuals on his telautograph, which order is reproduced on a companion instrument before the Chef's staff. When the dishes are ready they are placed on one of the eight dumbwaiters and the minute its door is closed it is automatically shot roofward. Just before closing the door, however, the kitchen attendant inserts a plug in the box mounted alongside the dumbwaiter door, each plug hole corresponding to a certain floor number. After this is done the dumbwaiter automatically takes care of itself and will stop at the proper floor without any further attention. When it reaches its particular floor, an alarm rings and the waiter knows that his order has arrived. Again, when a door on the upper floor is opened, the dumbwaiter is automatically locked, and cannot be tampered with by anyone else until this door is shut, when it once more automatically returns to the kitchen.

As just mentioned, the telautograph plays a very important part in the ordering of dishes between the waiters and the kitchen, but in many instances there are supplied speaking tube service and telephones. At the Biltmore, one of the very latest telephone systems has been installed throughout the kitchen, operating on the Turner Dictagraph principle. These 'phones are of the loud-speaking type and orders can be heard twenty feet away. In like manner the Chef may answer the conversation

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AudioTron Potentiometer and Rheostat Units are made of a special uniform composition and are designed to give silent, easy and close adjustment of battery potentials by a constant and gradual increase not possible with one cell variation. This results in maximum sensitiveness. The B battery unit is of 7000 ohms resistance, insuring long life to the batteries. Any lower resistance wastes your battery. The AudioTron Indestructo Filament Rheostat, having no wires to corrode, lasts a lifetime. Its ease of adjustment is also a big feature, and it adds to the appearance of your set.

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Less Lever and Knob ..... .50
Filament Rheostat complete 1.50
Less Lever and Knob..... 1.00
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Largest Line of Loose Couplers on the Market

All Styles, 200 to 15,000 M. All Prices, $4.00 Up

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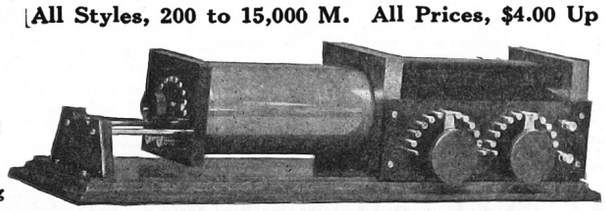

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ON A
SUPER-SENSITIVE DETECTOR

TERMS: Always Transportation Prepaid, Satisfaction Guaranteed, Cash

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Use the coupon on page 382 to-day.

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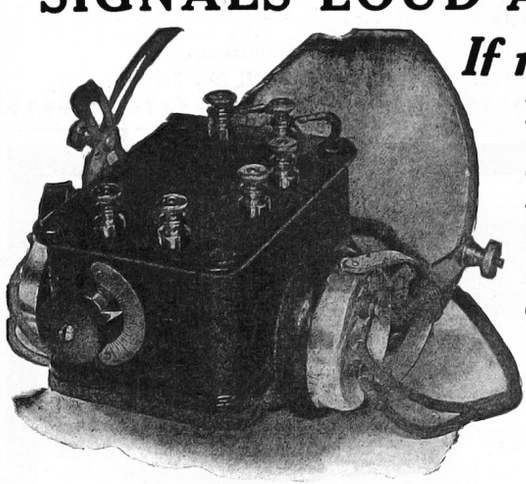

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"National" 50 Volt Tungsten Battery

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National 50 Volt Tungsten Battery, $4.00

We also make batteries of lower and higher voltage. Send for quotation.

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If You Want to Banish Detector Trouble Forever—Try Them

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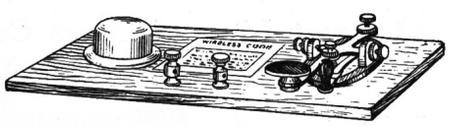
It consists of a regular telegraph key with circuit breaker, a high pitched wireless buzzer and a wireless code chart, mounted on highly polished panel. This set is to enable the beginner to master the code. The buzzer reproduces the sound of signals of a wireless station.



"National" Wireless Practice Set, $1.75

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Boys! Here Is Your Laboratory!

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Size of Outfit 12x12x3 Weight 4 lbs.

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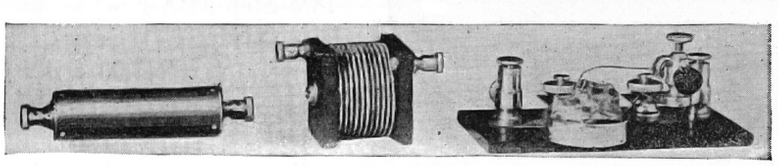

A New Tubular Mica Coudenser composed of a special mica possessing infinitesimal leakage. Its efficiency permits use across your tuners in place of massive load coils, to raise wave. Use in place of your present fixed condenser across phones and note quality of tone and amplification. We positively guarantee same or money back in ten days. A high efficiency permanent condenser, well finished, the only thing for Audions and crystal detectors.
Postpaid **$2.50 each**

Monotone Improved Quenched Gaps for spark coils and transformers need no introduction.

Span that "freak" distance during the summer.
Each $2.50

The Goldalloy Crystal Contact Detector will not receive from Mars but has been found to bring out all the receiving qualities possessable by the most sensitive crystals. Note adjustment and substantial design. With ¼ lb. crystals,
Postpaid, each $5.00

THE RICHARDSON CO., Manufacturers of Radio Apparatus ERIE, PA.

without stepping close to the instrument or jamming the receiver half way through his outer ear.

The problem of clean linen is always one of supreme importance in such hotels, where the large laundry is constantly in operation in consequence thereof. All the machinery in the laundry is of course electrically driven, including the washing, wringing and drying machines, also starching machines, electric irons, fluting machines and electrically heated mangles. A motor driven conveyor system carries the finished pieces to the linen room at the Astor.

The maid system in use at modern hotels is a great time saver. Instead of having to hunt through half the rooms on a floor to locate the room in which the maid is working, one has now but to glance down a corridor and a small illuminated electric globe marks her position at once. Moreover, when she lights the signal lamp in the hall alongside the door of the room in which she is working, this fact is registered on an annunciator downstairs. The "drop" corresponding to the room number falls and hence the Bell Captain knows just where each maid is at any instant, and if any particular maid takes five minutes longer to straighten out the room than thought necessary—well we leave that to your imagination!

Elevator service is of course of the best and as many as twelve *guests'* elevators alone are in use in some of the large hostelries. These are invariably equipped with some form of indicator over the door on each floor, which shows always at just what floor the cab is located in its travel. At the Astor a progressive lamp annunciator is placed on each floor, the tiny lamps lighting and extinguishing successively so that one may actually "see" the car rise and descend from floor to floor. Most of these elevator cars are also equipped with telephones for emergency purposes, are electrically lighted and have an electric flash lamp annunciator, on which appears a lighted bull's-eye corresponding to the different floors calling while the car is in motion. Also there is a diminutive fan, very essential on a hot day.

When it comes to entertaining it may safely be said that the first-class hotels of to-day are a whole show in themselves. At the Hotel Astor, for instance, there is one of the finest roof gardens imaginable. This is electrically decorated in a highly artistic manner with thousands of electric lights and numerous electric fountains. The grand ballroom at this establishment is one of the finest and most beautifully illuminated in existence. The various side lamps and chandeliers about this palatial enclosure may be controlled when desired by remote control dimmers operated from various points about the room, thus giving any degree of illumination desired. Besides, there is a marvelous electrically operated concert organ capable of producing music of wondrous volume. A portion of the mezzanine floor at the south end of the grand ballroom can be raised and lowered to form a platform or stage whenever desired. Foot and border lights are arranged the same as on a regular theater stage. This magnificent room is thus adapted to many purposes.

At the Biltmore the roof garden idea has been carried to wonderful extremes. One of the most beautiful innovations ever effected in a hotel dining-room is that where "The Cascades" are in operation. Here a multi-step platform constructed entirely of plate glass is built; under the glass plates are several hundred electric lamps of various colors, while an electrically lighted fountain surmounts the entire arrangement. The water flows from the fountain

downward over the illuminated glass steps, while the orchestra is located around the fountain. This combination is well calculated to please both the eye and ear of any pleasure-seeking connoisseur.

Electricity, the ever present servant, is thus seen to be at the beck and call of whosoever may care to pay the price. As an example of what some of these entertainment features cost, it may be mentioned that one of these modern palaces expended over $15,000 just to install an electrically operated ice plant in one of its smaller aerial gardens, so as to freeze the entire floor space firmly and thus provide a skating rink for the use of its guests!

Some of the miscellaneous features of interest to the electrician are the electric carriage call, motor driven vacuum machines for sweeping, floor scrubbing and polishing machines, watchman's clock system, electrically synchronized clock system, electric signs used for advertising, et cetera.

The Astor has a unique advertising feature in the form of a flag, which flutters in the beam of a powerful searchlight mounted on the roof. This lamp consumes 1½ kilowatts.

And after you have paid your bill you make your way to the large revolving door at the entrance of the Astor. According to time-worn custom, you brace yourself to revolve that door, mule-like, as you do back home in your office building. But not so here. For this particular door has a one-eighth horse-power electrical motor hitched on to it and just when you reach it an attendant, who does nothing else, pushes a button and the door revolves as if by magic. Flabbergasted at this trick, you find yourself on the steps while the "starter" already beams at you with: "Taxi ready, sir!"

KILLING SHARKS BY ELECTRICITY.

(Continued from page 314)

from the reel at rest. A slight pull at the cable, however, immediately sets the reel revolving and the breaker C, with its contact B, now makes contact with the ring-shaped piece A. This is connected to the mains of a small 220 volt alternating current dynamo giving about five amperes. The other pole is "grounded" (connected) to the boat's outside metallic plating. Now salt water is an excellent conductor for the electric current and the circuit will naturally be closed very effectively by way of the sea and the shark's body and from there through the bait cable, back into the dynamo.

Thus it becomes evident that the full current strength of 1,100 watts must pass through the shark's head once he has the bait in his jaws. Nor can he let go as the jaws will set like a vise due to the paralyzing action of the powerful current. As the shark is entirely immersed in a first class conductor—salt water—and his wet body is almost as good a conductor, the conditions for his electrocution could indeed not be more ideal. In less than ten seconds he must have been shocked to death, particularly because most of the current has passed directly through his head. As he swirls around in his death agony more cable is played out and the reel spins around as it does so. This causes the circuit breaker to open and close the current a number of times in quick succession, which is desirable, as it gives the shark powerful shocks impossible of being withstood even by a whale.

If another shark lurks around and attacks his electrocuted brother—as sharks are wont to do—his fate is likewise sealed. In all probability he will be electrocuted too.

After the shark has thus been killed, an attendant turns off the current and winds

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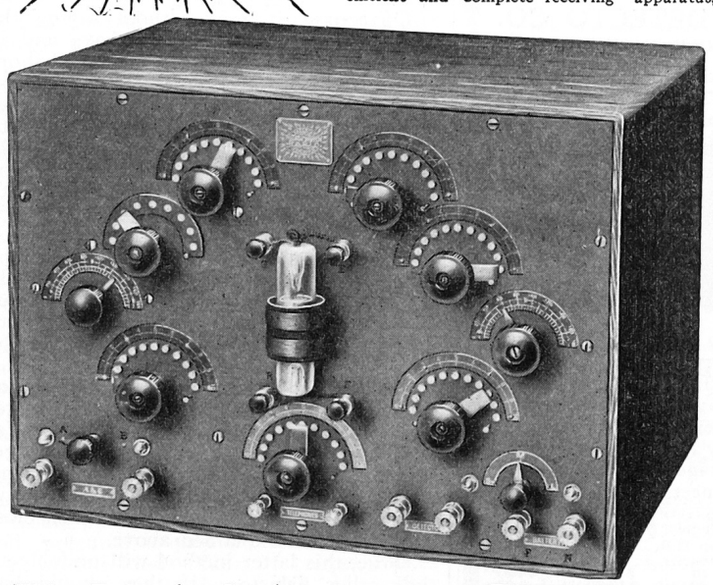
THE name "MIGNON-SYSTEM" on radio apparatus has a very definite meaning. We build only **Complete Cabinet Types** ready to be used instantly with any type detector without disturbing its internal wiring. "MIGNON-SYSTEM" assures you of all parts of your set dissolving into one effective UNIT.

You can buy "MIGNON–SYSTEM" apparatus in individual-unit cabinet and sets running from the RC1 to this most efficient and complete receiving apparatus, the RLC7, here illustrated.

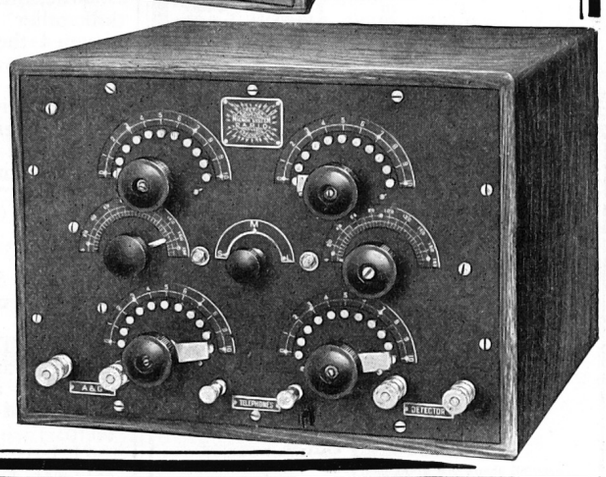


Undamped Waves

The reception of undamped or continuous wave signals is *fully guaranteed* with our "RCS9" and "RBD8" cabinets used in conjunction with any form or type of tuner — receive any and all Radio signals from any form of Radio Transmitter.

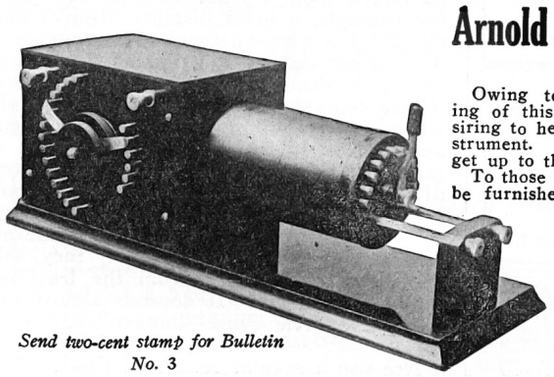
You will want to know all about these new 'MIGNON-SYSTEM' sets—how they are built, how they are tested, what they can do.

Write Today for Catalog R-7 and mention The Electrical Experimenter—it contains large illustrations of all the new cabinets, together with full descriptions and wiring diagrams.



Mignon Wireless Corporation

Elmira - New York



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To those ordering an instrument such Hook-up will be furnished gratis.

It is as in the past the Right instrument to do all first class receiving with. Workmanship and material the best.

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6 C 2	6	40	10.00	6.00

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up the reel; the has-been man-eater can then be hoisted up and dismembered as is the seaman's fashion. The pieces can either be thrown overboard or else can be used as bait to catch the next sharks. The latter is a good method, for shark likes shark.

In case the bait cable should break during the shark's death convulsions, no harm is done, as he is probably dead by that time and the purpose is accomplished. And cable is cheap. Apparently, this plan should be readily accepted by municipalities along our shores, particularly by seaside resorts whose greater income depends on the bathing public. A few dozen of such electric boat patrols would quickly rid our shores of these pests at small expense. The boats we have already; practically the only item of any consequence is the dynamo. This can be had for about $86.00. The reels manufactured in quantities should not cost over $15.00 apiece. Three deck-hands would be sufficient to kill a hundred sharks a day.

Of course, it goes without saying that this scheme is applicable to bays and inland creeks as well. In this case the shores of the shark-infected river can be equipped with a number of reels stationed at intervals. One fair sized dynamo-generator can take care of practically any reasonable amount of reels, as it is unlikely that more than one shark will be electrocuted at the same instant.

The beauty of this scheme is that it is almost entirely automatic and needs but little attention. Nor are the sharks frightened away as by useless dynamiting and shooting. By running the generator during the day and especially at nights, maximum efficiency can be obtained and it should be only a number of days before the last shark is killed. It is also entirely feasible to suspend the bait a few feet under water, simply by adjusting the reel as desired. No current is passed through the bait in this position till the shark gives a strong pull at the bait line, which closes the circuit as explained above.

True, this latter method will undoubtedly kill other fish too (if they should have escaped the sharks), but the means justify the result and its accompanying small losses.

The writer is aware of the fact that shark experts will call the proposed scheme unfeasible. They will say that sharks are far too timid to come so near a moving vessel. In answer, let us quote Mr. Chapman Grant of the New York Aquarium staff. In a recent interview this expert said:

"Shy as it is, the shark will not hesitate to attack whatever its size can cope with, if hunger drives it. That shyness is excessive. There are times when they will snatch at anything that is white and gleaming; thus a white bone or a metal jig is enough of an invitation to their mighty teeth.

"I have caught them myself that way," said Mr. Grant. "I have caught them 'way up rivers, too. Up the Tammassee River, for example, a good distance from Tampico. I have known them to be caught at the farther end of a chain of five lakes. There is absolutely no grounds for the theory that sharks will not inhabit fresh water. They will go anywhere, if their hunger leads them there. They have been caught in Venezuelan lakes and in lakes of India. And sharks are the most temperamental of creatures. One day they will be ready to strike boldly at whatever crosses their path; the next day they will flee in nervous fright from the least of things that moves. It depends almost entirely upon one cause—hunger."

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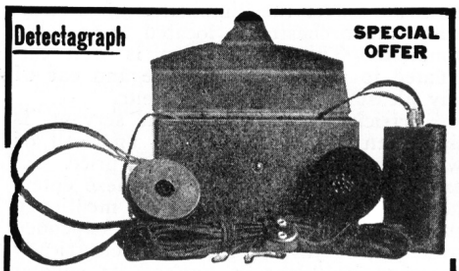

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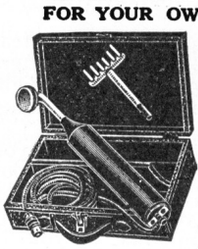

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on. No attention given to unsigned communications.

HIGH FREQUENCY INTERRUPTION.

(88.) W. J. Madole, Washington, D.C., writes as follows:

"Kindly advise in reference to practicability and patentability of following described apparatus for producing high-frequency electrical current interruptions for radio purposes:

"(a) A selenium cell in a circuit to be interrupted; a strong beam of light focused on this cell.

"(b) A means for rapidly interrupting this beam of light, possibly in the shape of a wheel of flat disc-like form with narrow slits or light openings spaced around the periphery, this wheel revolving between the source of light and the selenium cell in such a position that the light will reach the cell through the above said slits or light openings. A wheel of say 36" diameter, having 1,000 such light openings around the circumference, revolving at 3,600 R.P.M. or 60 revolutions per second, would produce a frequency of 60,000 per second. Size of wheel, speed, number of openings, etc., could, of course, be varied."

We think this idea has been tried before, however, without much success. There is such a thing as lag in the operation of a selenium cell, which prevents their acting if the light is interrupted at too high a frequency. The inertia of the selenium cell is too great, for it takes a certain amount of time before the selenium in the cell becomes a conductor and before it becomes a non-conductor again. This time element is quite considerable, and to our knowledge there are no cells that would be able to produce a frequency of 60,000 per second; at least we have never seen a cell that could do this.

INSULATOR.

(89.) Harry Bremer, of Jersey City, N.J., has submitted to us an insulator to be made of glass or porcelain, and, instead of using wood or iron pins, which decay or weaken, our correspondent proposes to make the entire insulator in a certain manner entirely out of glass or porcelain. Mr. Bremer wishes to know if the idea is practical, and whether a patent could be obtained on it.

While the idea certainly has some novel points, we doubt very much if a patent could be obtained on it. There are so many patents on insulators at the present time that it would be necessary for a patent attorney to make a search in the Patent Office, and we would advise you to do so. As far as practicability goes, the insulator is entirely practicable to our minds as long as it concerns a small insulator, not more than 3" high. If the insulator is made very large, we believe the cost of making it entirely in porcelain would be prohibitive, and, moreover, it seems that the pin shank would be weak in proportion to the size of these larger insulators.

MOVING TOY.

(90.) Daniel E. Sullivan, New York, N. Y., has submitted a very clever drawing of a moving toy in the shape of a tramp being chased by a dog, both figures moving at the same time. He wants to know if a device of this kind is patentable, and whether commercially feasible.

This is a very good idea, and we have no doubt that a patent can be obtained upon the idea at the present time. Due to the shortage of toys from Europe, a device of this kind should prove of distinct advantage to an American manufacturer, and a great many articles such as these are in wide demand. Our advice is to get in touch with a patent attorney.

COLLISION PREVENTER.

(91.) John T. Dwyer, North Philadelphia, Pa., sends in a very lengthy description and drawings of an ordinary direction signal, which he claims should prevent rear-end collisions on railroads. The underlying idea is to use two tubes, containing a partial vacuum, in connection with a relay which in turn would give the alarm and thus warn the engineer in his cab. The vacuum tubes are supposed to be connected in shunt with one of the axles of the locomotive.

This scheme is entirely unfeasible, for the simple reason that not enough current could be forced through the vacuum tubes. It would be necessary to have at least 1,000 volts potential to pass a current through a tube of this kind. This, of course, makes the scheme entirely impractical. If another means instead of the vacuum tubes can be substituted, the device might work, although we have our doubts.

PATENTS

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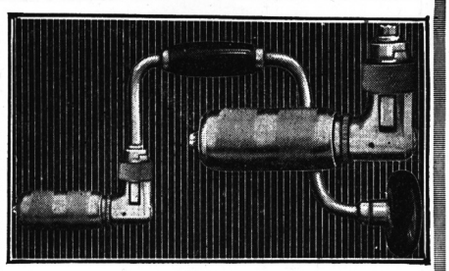

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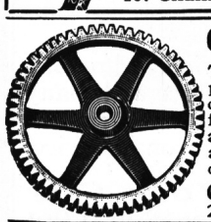

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SPARK WIRELESS TELEPHONE.

(92.) E. M. Bailey, Woodsdale, N.C., sends description and drawings of a *spark* wireless telephone which presents some new features. He proposes to control the dynamo by means of a heavy current transmitter. Our advice is sought on this arrangement.

We must discourage all *spark* wireless telephone schemes, as they have all proven uniformally unsuccessful so far. Any wireless telephone using an ordinary spark gap and spark coil, unless some entirely new and as yet unknown device is used to change the spark characteristics, will not work. The interrupted spark note interferes with the working, and speech received can never be clear.

TELEPHONE SERVICE IN HAWAII.

The total value of the plant of the Mutual Telephone Company which controls the automatic system in Honolulu, Hawaii, is $891,502; operating and general expenses last year were $161,483 and income $290,450. The income for 1914 was $264,-095. There are bonds outstanding amounting to $260,000.

FOUR WATERFALLS COULD TURN ALL WORLD'S WHEELS.

If some clever electrical engineer will invent a system by which electric power can be transmitted over wires to a distance of from 6000 to 8000 miles without serious loss, the world need not worry about the possible or probable exhaustion of its coal and oil (it has been calculated that these will be exhausted within one hundred years if the present rate of increase of consumption continues), for there are four waterfalls that can supply far more than enough power to turn all the wheels in the world. These are, Victoria Falls of the Zambesi, our own Niagara, the La Guayra Falls of the Parana River, and the Iguassu Falls of the Iguassu River, both of the latter close to the frontier of Brazil and Paraguay.

The total horsepower derived from burning coal and oil, direct and indirect, is more than 30,000,000 in the whole world.

The Victoria Falls is alone capable of furnishing 35,000,000 horse-power.

Iguassu Falls, it has been estimated by an Argentine engineer, can supply at least 10,000,000 horsepower.

La Guayra Falls can furnish about 12,-000,000 horsepower.

United States Government hydrographers calculate that the streams and rivers of the United States are capable of giving 230,800,000 horsepower.

The difficulty in the way of utilizing the giant falls of the Zambesi, the Parana and the Iguassu is that they are all from 600 to 800 miles from the points to which it would have to be carried, and almost trackless wilderness lies between.

Here then is a problem worthy of an Edison, a Cooper-Hewitt, a Marconi, a Tesla or a Pupin; a task that, solved, will earn for its sponsor, an undying fame.

$25.00 to Anyone Who Solves This Electrical Problem

In the belief that the description, explanations and requirements printed in the August issue were not clear and that this is the reason why we did not receive more replies, we therefore reprint here additional desideratum:—The problem to be solved is as follows:

The steel bar B, (refer to drawing in August issue) must be attracted by the electromagnet A at a speed of from 10 to above 50 times per second. B is held back by a spring and it requires about 5 lbs. pull by the electromagnet A to be operated. The distance from B to A, normally is ¼" and when B is attracted by A, it stops 1/16" from the electromagnet, so that the net distance traveled is 3/16". The electromagnet A, because of lack of room, cannot be above ½" diameter and 2½" length, unipolar design, with solid, Norway iron core, ¼" diameter. The device that produces the vibration of B should be so arranged that it will be possible to set it for a certain frequency of pulsation, from 10 or less, to 50 or more per second, and once set, it should not require other adjustment for at least 6 months.

Good results have been obtained by using an interrupter like the one illustrated in the August *E. E.*, but the great drawback is that, in order to obtain the required pull from A it was necessary to use 24 volts and 6 amperes of D.C., and such a high current produces an arc from the electrode D to the carbon electrode E, causing the electrodes to wear out in a short time, and moreover, requiring careful readjustment every few days. A commutator cannot be used as such systems are already patented. Mercury cups or oil baths and magnetic blow-outs are not practical. You can either improve the interrupter or entirely redesign it. The current to be used in operating it can be D.C. or A.C. (D.C. preferred) at from 6 to 110 volts.

Our subscriber is willing to pay $25.00 for the best suggestion that shall prove acceptable, made by any reader of THE ELECTRICAL EXPERIMENTER who can solve the problem for him. The offer is absolutely genuine and the contest will be conducted as follows:

There will be a board of four judges as follows: Two of the editors of THE ELECTRICAL EXPERIMENTER will constitute one side, while our subscriber and another engineer will constitute the other side. This Board will read all letters and suggestions and will select the most satisfactory answer. The result will be published in a coming issue of THE ELECTRICAL EXPERIMENTER and the winner is to receive $25.00 at once at the close of the contest.

The party who is to receive this information from any of our readers (if it is satisfactory) becomes the sole owner of the idea. It is not necessary to offer any experimental evidence as to the working qualities of the proposed circuit or mechanism, but as long as the device or suggestion made to him is entirely *practicable* and *feasible*, a prize of $25.00 will be paid the successful contestant

The suggestions and drawings must be made *clearly* and *concisely* and the exact size of the various parts, if drawings are forwarded to us, must be also given, so that we shall be able to form quickly the best opinion as to the working qualities of the individual suggestions.

All communications should be addressed to "Editor, Interrupter Contest," and the following rules should be observed.

Sheets should be written on one side only.

No pencil writing acceptable.

Drawings must be on a separate sheet; all drawings to be in pen and ink.

In case the idea proves acceptable to our subscriber propounding this problem, he, on payment of $25.00 for the idea, immediately assumes control of the device as well as all patent rights belonging thereto. The sum of twenty-five dollars has been deposited with the Experimenter Publishing Co., to be paid over to the winner. The contest closes September twentieth and no letters will be considered after that date.

THE TELEPHONE IN MODERN WARFARE.

(*Continued from page 315*)

second field artillery at Fort Meyer, Virginia, giving orders to a group of gunners, at a distance, by using this ingenious and efficient little military telephone-telegraph outfit. The complete instrument is supported by a leather strap which is held on the operator's neck. This gives him one free hand to operate the telegraph key. The knob of the key is also enclosed in the case, but at the point where the key knob is located a fine flexible leather is placed over the case, so that it permits the operator to depress the key with great ease.

The wire seen hanging from the case in Fig. 4, is used as a line between the observation officer, and the officer who is in charge of the gun crew, Fig. 5. When telephonic communication is required, the cover supporting the telephone transmitter is raised from its position until both back springs clasp two notches; this automatically connects the transmitter with the telephone current, and disconnects the key from the telegraphic side. The loud-speaking telephone is automatically connected in this line ready for duty. This method of receiving orders from a distance without wearing head 'phones, is, of course, highly advantageous, and the incoming vocal sounds are so loud, that the sounds accompanying actual warfare conditions do not interfere with the conversation.

The complete unit is substantially built and all the instruments are rigidly mounted in a heavy leather case, which only weighs about four pounds.

Most of us are aware of the fact that conversation between persons in an aeroplane traveling at a speed of 100 miles an hour is extremely difficult, due to the rapid air currents and engine noises.

This problem of improving such conversations on aeroplanes has been taken up extensively by the different nations of the world, which found that the *telephone* is the best suited for the purpose. Several types of instruments have been developed during the past few years, some of which have proven a total failure. These have been tested in actual service in Europe, while others that are being used are not as satisfactory as they might be. However, as they cannot obtain any better ones at the present time, they are forced to use them. The same company that has developed the portable military telegraph-telephone outfit for artillery requirements, has recently developed an excellent aeroplane telephone, which is, perhaps, the most successful ever designed. It is illustrated at Fig. 6.

The telephone transmitter is of peculiar design, and is so supported in a frame that it can be regulated to suit the operator. The microphone itself is of rugged construction, in order to withstand rough usage. The two straps of metal supporting the transmitter are used also as conductors for the instrument. They are properly insulated on the transmitter back. The receiver is located on the top of the helmet and is covered with leather so as to protect it from outside damage. The sound produced by the receiver is conveyed through two conical horns, to the ears of the operator. The large opening is indicated in the photo by the extended leather channels on the side of the aviator's ears. The ears are protected by soft leather padding, which at the same time exclude external noises. With this ingenious scheme of employing two conical horns the sound is so immensely amplified, that all other noises are drowned out. The electrical connections are made with a double flexible conductor, having a plug on each end. The plug is inserted in a special jack re-

(*Continued on page 374*)

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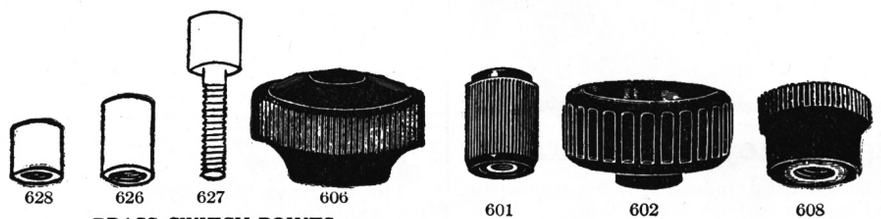

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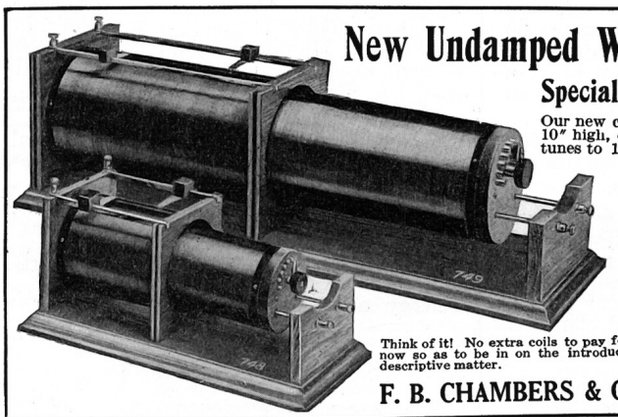

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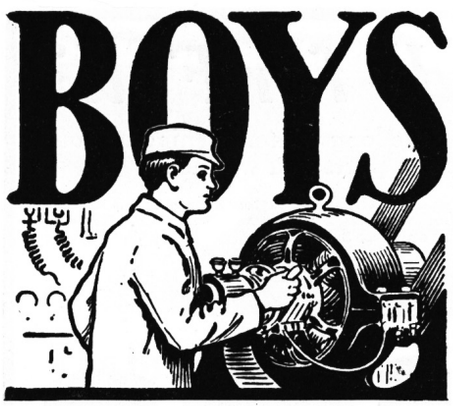

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ELECTRICITY DIRECT FROM SUNLIGHT.

(*Continued from page 317*)

the detail view of the cell here reproduced.

A partial explanation of the "illumination voltage effect" may be interesting along the lines observed by Professor F. C. Brown, in some papers on light-sensitive selenium.

The idea is that light lowers the stability of certain electrons in the copper oxide crystal structure. As a result the electrolyte absorbs these electrons of low stability and the back plate in turn absorbs the electrons from the electrolyte. Or the electrolyte acts as an intermediary to continually transfer the unstable electrons from the illuminated plate to the dark plate.

The *electrons* travel away from the copper oxide in the electrolyte and from copper to copper oxide in the external circuit. The flow of current is from the front plate, along the connecting wire to the rear copper plate.

The electrolyte serves rather as an equalizer and probably to make copper oxide. The polarization observed is very likely the same as that observed in ordinary batteries. The electrons travel through the electrolyte on electrolytic ions and probably collect on the back plate as gas bubbles, etc.

It is of interest to compare the efficiency of the new illumination battery to that of a corn crop, as very conservatively estimated by Prof. F. C. Brown:

A plate 22"x29"=4000 sq. cm.—
which probably received about 1 cal. (calory) per sq. centimeter 1 minute on a clear day.

Energy received equals 4000x1=4000 cal./min.

$$\text{Energy received equals } \frac{4000}{60} \times 4.2 = 280 \text{ watts.}$$

Energy output=volts x amperes:
.1 x .2=.02 watt.

$$\text{Efficiency} = \frac{.02}{280} = 7 \times 10^{-5} = .007 \text{ per cent.}$$

The mechanical efficiency of land devoted to the production of corn, on the assumption that the corn is fed entirely to the most efficient work animals.

Mechanical work to be obtained from every sq. cm. of soil is:

$$\frac{\text{bu. per acre}}{\text{sq. cm. in area}} \times \text{net lbs. in bu.} \times \text{cal. per lb.} \times \text{efficiency of horse equals}$$

$$\frac{50 \text{ bu.} \times 50 \text{ lbs. net} \times 1.6 \times 10^6 \text{ cal./lb.} \times .30}{4 \times 10^7 \text{ 2}} = \frac{30 \text{ cal.}}{\text{cm.}^2 \text{ yr.}}$$

Amount of energy received from same per year=

$$390{,}000 \frac{\text{cal.}}{\text{cm.}^2 \text{ yr.}}$$

Efficiency of land is

$$\frac{30}{390{,}000} = 7.7 \times 10^{-5} = .0077 \text{ per cent.}$$

Thus the mechanical efficiency of the cell just described compares favorably with the best land, under the sun's energy, so far as the mechanical output is concerned.

Finally two theories suggest themselves by which the action of this cell may be explained:

1—The electronic theory;

2—The chemical theory; namely, that the front plate, or contiguous liquid layer, undergoes chemical change, under the influence of light, which causes a flow of current.

At present, the evidence seems to point rather to the electron theory as the conditioning agent, and the chemical theory as a secondary effect and not the primary.

THE DAWN OF ELECTRICAL RAILROADING.

(*Continued from page 318*)

ure is attached to the famous *Olympian* flyer and is on its way crossing the great Continental Divide. The total locomotive equipment includes forty-two units, each one of which costs about $112,000 to build. The weight of the single locomotive is 284 tons and it is capable of hauling a 3,200 ton load up a one per cent grade at a speed of sixteen miles an hour. Similar electric locomotives geared for higher speed will haul an 800-ton passenger train over the same stretch of road at a velocity of sixty miles per hour.

Compare for a moment this monster electrical speed demon, with the wood-burning locomotive of half a century ago, weighing less than twenty tons, with a tractive power not exceeding 5,000 pounds. The highly perfected Mallet steam locomotive of the present day exerts a tractive power of 76,200 pounds, while the monster electric locomotive in use on this wonderfuly developed road weighs 284 tons apiece with a tractive effort of 85,000 pounds. These locomotives measure 112 feet 8 inches in length and are driven by separate, direct current motors twin-geared to each of eight pairs of driving wheels. The cab extends nearly the whole length of the engine.

In the general operation of the system many unique features are brought into play, some of which have never been used heretofore, at least to any great extent. One of these features involves what is known technically as *regenerative braking.* This covers a method used on down grades on each train instead of consuming electrical energy, and actually produces it while traveling, and at the same time the speed of the train is kept under perfect control.

This follows from the fact that electric motors are reversible in their functions, i.e., while they absorb electrical energy and give out mechanical power, when ascending grades, they can, moreover, perform the reverse of this operation and absorb the mechanical energy resulting from the down grade travel of the train, due to gravity, and transform it into electrical energy. Thus these electric locomotives provide a perfect braking system which is independent and separate from the usual compressed air brakes, these latter being used only in emergency and for stopping trains. Further, this electrical energy when generated is returned to the trolley wire to assist other trains and thus produce an amount of electric current which is actually utilized and which, of course, costs a certain amount of dollars and cents for every watt and kilowatt consumed.

In actual operation at the crest of the grade the helper or (pusher) locomotive is brought to the front of the train and coupled with the forward locomotive, both being operated as a single unit. The train is then controlled on the down grade by braking. This system of electrical braking provides maximum safety, it is claimed, and besides it eliminates excessive wheel brake-shoe or track wear as well as overheating. It moreover insures uniform speed on down grades and returns electrical energy to sub-stations which can be utilized by other trains—from 25 to 52 per cent of power is actually recovered in this way.

It is only a matter of time, and it really seems a very short time, before electrical energy for railroad work will receive wide-

spread acceptance for a number of pertinent reasons. One of these is efficiency, as applied in an over all sense, and which as every engineer knows, spells either profit or loss, depending upon the balance between the net earnings of the system, be it large or small, and the net cost of upkeep or maintenance.

As a matter of fact a large sized high voltage hydro-electric project, such as the one described above, will realize in many instances an over all efficiency considered from the water-fall to the locomotive driving wheel of 55 per cent. Compare this with the efficiencies attained on any modern steam railroad. The best authorities state that a steam locomotive, when operating under the most favorable conditions with regard to speed, load, grade, etc., does not exceed a gross efficiency, from the pounds of coal burned in the fire box to the driving wheels, of 12 to 15 per cent. Some railroad authorities claim as high as 18 to 20 per cent. efficiency for steam locomotives of the latest compound type, with steam super-heating apparatus, but it seems very doubtful if such a value is actually attained in practice. The efficiency of the electric locomotive is very high, ranging from 80 to 90 per cent. Judging from past performance in this direction, it seems fully evident that electricity in its application to railroad transportation problems has come to stay.

TIMING THE FREQUENCY OF MUSICAL AND VOCAL SOUNDS.

(*Continued from page 320*)

prevailing conditions of fusion, and also that they shall be widely enough spaced in both directions to be easily read. It is also essential that a single little sensitive flame shall light up the whole exposed surface of the screen.

A fundamental requirement in this principle of measurement is that the light shall be made intermittent through the action of sound waves. This may be accomplished in various ways. In the simplest arrangement an ordinary manometric capsule is used, and the singer holds a funnel before his mouth in such a way as to effectively collect the vibrations. Acetylene gas supplied by a motor-cycle tank is used for this sensitive flame.

While this mechanical transmission through a manometric capsule is for most purposes the simplest means, and is entirely satisfactory, especially in singing, we have electrical devices that have distinct advantages. The receiver of a microphone may be converted into a manometric capsule by building a gas chamber on the ear side and supplying it with a gas inlet and a jet nipple. The vibration of the receiver membrane controls the gas

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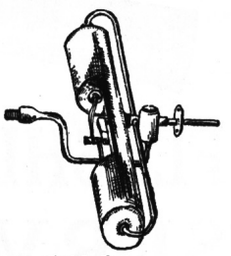

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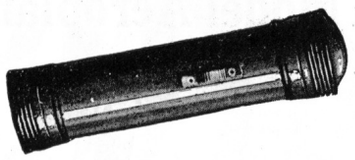

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UNEVEN OLD WAY

flame in the same way as in an ordinary capsule. The microphone transmitter is used with this as in ordinary speaking. The best type of commercial instrument that may be readily adapted for this purpose is the Phonette or the Acousticon.

While the electrical apparatus may be a little more delicate to handle it has the advantage that it is more sensitive and can be used for the recording of a tone which would not be strong enough to register in any other way. It also makes it possible to set this apparatus in front of the singer so that he may sing for a record without being aware that a recording instrument is present in the room. The singer may be isolated in a quiet room or in familiar surroundings, in order not to be disturbed by the presence of another person and the main instrument. The measurement may even be made at any long distance covered by telephone connection, as all that is necessary is to put the microphone transmitter in front of the singer at one end of the telephone line, and connect it with the microphone receiver on the tonoscope at the other end.

Under the same circumstances a vacuum tube may be used in place of the gas-flame capsule. The intermittent light is then caused by the interruption of the current in the primary circuit of an induction coil which has the vacuum tube in the secondary circuit.

The stroboscopic reading requires fairly complete darkness. To avoid darkening the room a hood (not shown in the figure) has been built to fit over the reading surface of the tonoscope. This hood forms a dark chamber and the inner surface, being bright, serves as an excellent reflector for the light. For intensive reading at a given point on the scale, a small sliding hood is made on the same principle. It has the advantage of centering the light upon the point of reading in the scale. A reflecting mirror (not shown in the figure) is used to distribute the light over the visible portion of the screen for ordinary use.

To obtain musical notes from the tonoscope the siren blow-pipe is connected with a compressed air tank or it may be blown directly by a mouth tube. A speaking tube is used to carry the sound to the observer's ear and the opening and closing of this tube by means of a clamp starts and stops the sound.

The siren tone is not a tone of good quality. But a beautiful tone may be produced by projecting a beam of light through the holes in the screen upon a selenium cell in circuit with a telephone receiver. It so happens that the fluctuation in the resistance of the selenium cell takes approximately the form of a sine curve, and that produces a tone of most remarkably clear and smooth timbre in the receiver. One may, however, use any sort of instrument for giving the standard tone, as the pitch of the instrument can be read off on the tonoscope at any moment.

The reading is simple and direct. The first task is to see which row stands still, or the nearest still. This row indicates the desired record and will be seen irresistibly the moment the tone is produced, because all other rows are blurred or in rapid motion.

The tonoscope furnishes us the first ready and, at the same time, reliable means of measuring directly the pitch of a tone as sung, spoken, or played with a musical instrument. Heretofore, graphic recording has been the only reliable method. This has the merit of accuracy but is entirely too indirect and laborious to be of general use in practical work. As we have seen, it registers the tone as sung or played under natural conditions, and the record is simultaneous with the tone. The scope of its usefulness is therefore very great. It furnishes us an approach to countless problems both in pure and applied psychology. The psychology of tonal expression is a field practically unworked as compared with the psychology of the appreciation of tone, largely because we have not before had any convenient means of measurement.

The settling of disputed questions of pitch has been interesting. For example, there was a pitch discrepancy in the playing of the oboe and the French horn in a symphony orchestra. Each player was given an opportunity to register a specific tone in the tonoscope, and it was found that the oboe was playing consistently 1.5v.d. flat. A vocal soloist had a tendency to flat relatively high notes. She observed the error and learned to make the right correction. A singer was practicing to eliminate an undesirable fluctuation of the pitch of the voice and was much helped in practicing before the tonoscope as before a mirror.

There is a conspicuous place for the tonoscope in the musical conservatory. The ear of the singer or player is too generous because it seldom has any objective correction. The pupil persists in constant errors becouse there is no objective check on the ear. But the tonoscope does for the ear what the microscope does for the eye. It magnifies and objectifies to the ear, bringing out even small details of the pitch of the tone.

An actual experiment in training of the voice by the use of the instrument revealed among other facts the following: A group of six singers practicing daily for twelve days, part of the time with the instrument and part of the time without it, showed that the average result of training with the instrument was superior to the average result of training without it, by forty-two per cent. in the ability to strike a tone, by fifty-five per cent. in the ability to sing musical intervals, and by twenty-six per cent. in the voluntary control of the voice in sharping or flatting; and the ability gained by virtue of the aid of the instrument was transferred in large part to ordinary singing.

THE UNTERRIFIED AMATEUR.

(*Continued from page 325*)

ought to be on the inside of a closed glass bulb, and is on the outside; it is distinctly annoying.

However, to make a long story short, eventually the bulb was done. It was not beautiful; I would say it looked like a diseased potato, only I hate to hand an insult like that to any honest tuber, especially an unfortunate one. It was not uniformly convex, let it go at that; but at least the works were all inside.

There is nothing more pathetically out of place than a premature sigh of relief. We gave one when our bulb was done, and thought our troubles were over. Over? Odds-fish! as Shakespeare says; we had only sown the seeds of trouble and the crop wasn't up yet.

There was our bulb; the next thing was to put a vacuum inside of it. On looking into the subject of the vacuum, or I should say vacua of different degrees of vacuousness, we learned that the one we required was of the class known as "some" vacuum and not the common, or five-and-ten-cent-store variety, such as occurs in the steam-pipes of a winter's evening when the janitor is absent at his lodge meeting. Patiently dropping back another step, we built a mercurial pump on the lines laid down by one—Sprengel.

Now I doubt if Sprengel invented his pump as a grudge against us "bugs," though if he did he must have died happy, if he has died; for the purchase of the mercury

threw us, financially weakened as we were, into profound bankruptcy, while the operation of the pump deprived us of hundreds of joyous hours which it should have been childhood's privilege to spend in chasing butterflies, or golden-haired high-school girls.

We hitched on our poor, mis-shapen bulb and began pouring that mercury. You put it in at the top, I recall, and it gurgled down through the thing till it came out at the bottom and you caught it and started it over again. Its gurgling was supposed to gurgle the air out, but somehow it didn't. That is, after securing a moderate vacuum, there seemed to be always more air to come.

Of course, Sprengel had his alibi; he said there was a lot of air "occluded" in the pores of the glass. This occlusion was a "new one on us," and it seemed like a mighty roomy place to store air, if you wanted anything of that kind; but we believed implicitly in good old Sprengel, and pumped, and pumped, and pumped.

You've heard of Mrs. Partington and her mop. Mrs. Partington was dissatisfied, for some reason, with the prevalence of the ocean near her home; and, observing that her mop would transfer water from place to place, and that the sand of the beach absorbed it quite readily, she undertook to tuck the ocean inside the beach by this means. People familiar with hydrostatics, doubt the truth of this story, but they fail to make enough allowance for feminine determination. No one accustomed to a "spring cleaning," the way a fussy housekeeper does it, would see anything improbable in the yarn.

Well, our case was much the same as Mrs. Partington's; for, as we discovered afterward, there was an invisible crack in our bulb and, to get a vacuum, we should have had to pump the earth's entire supply of atmosphere through it. I have to admit we gave up the job. It was the first job that completely stumped us. But it served a purpose (you can always find some good blow in an ill wind) for it implanted in us a germ of distrust in our scientific power. Only a germ, mind you, that's all; but it eventually blossomed into the winning modesty that distinguishes us to-day.

I hate stories of failure, and I wouldn't tell this one, except to show how nearly impossible it is to discourage a real "bug." He is like our bulb, in one way: you can exhaust any amount of enthusiasm out of him, by failures and disappointments; but he is connected up with the world's main stock of enthusiasm, and you couldn't draw his "pep" down to three millimetres by the application of "outrageous misfortune" for a lifetime.

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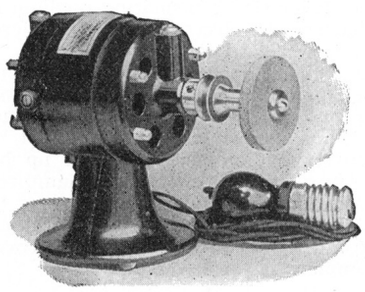

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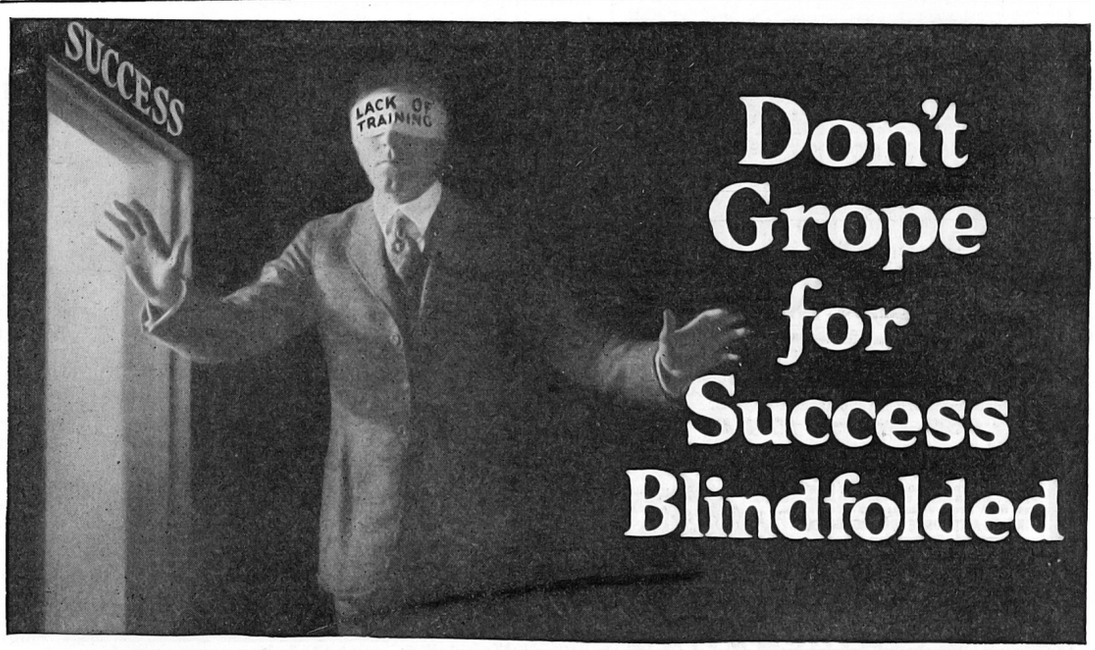

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THE ELECTRICAL MECHANISM OF THE ETHER.

(*Continued from page 326*)

In the dielectric or insulating medium of a condenser the electrons are considered *tied,* as it were, to the material atoms or molecules of the insulating medium. They are not supposed capable of extended migratory movement from the individual atom. Thus for an alternating E. M. F. large current volumes can be set up but cannot, however, be maintained unidirectionally to any considerable extent. Of course, in conductors this limitation is not present and the electrons are free to travel in a complete physical circuit.

The question can also arise as to how an alternating current can be maintained when there is nothing but the ether between the plates of a condenser. Would such a medium constitute a perfect insulator? The answer for an alternating E. M. F. is, "No." In fact, besides the Lorentz electrons, *with, however, a material nucleus added,* one must, because of this, fall back on a true Maxwellian, purely etherial displacement. According to modern electron theory the true Maxwellian, purely etherial displacement is always present in a dielectric, but superposed upon it in material media is an *electronic displacement, with a material nucleus.* The original Maxwellian displacement was structurally undefined. In insulators the electrons are *tied,* but in material conductors the electrons are *free.* It would be expected that since the electrons have a material *core* that these elemental charges should be associated with material media, but the true ether displacement currents of Maxwell, in which the material core is absent entirely, offers considerable difficulties to our understanding or rather visualization.

In the older theory, such as that of Ampere, the current flowing in a conductor was considered to be altogether distinct from the current flowing in a condenser. It was Maxwell who insisted, however, that a condenser current in the insulating medium itself must set up magnetic effects equivalent absolutely to those set up in a conductor of like current capacity.

Nowadays the conductor current of Maxwell's mysterious days is pictured as being due to an electronic stream of particles having a material nucleus, but the old purely etherial condenser current of Maxwell has still held its ground but superposed upon this current notion is the one in which, for material dielectrics, electrons are in addition considered to be displaced to a limited extent just as in the old Maxwellian ether displacement current.

In considering the manner in which light reaches us from the sun, since this is understood to be an electro-magnetic wave phenomenon, it would appear to be really of the nature of a true Maxwellian (or pure Lorentzian) character. That is to say the light waves in leaving the sun pass out like straight line streamers of a reeled off link chain in all directions. The one set of links lying in a plane, see Fig. 1, represent the displacement circuits of electricity, which Maxwell pictured as due to a flux of pure ether particles in such a circuit.

On the other hand the links looping the first set of links in a plane perpendicular to the latter, represent the closed paths of magnetic disturbances which Maxwell considered was due to what he called "idler" ether particles. Now, in considering electro-magnetic waves set up by an aerial in wireless telegraphy, the original displacement loops are not considered to lie wholly in ether, as they must do, when electric waves in the nature of light are sent out by the sun.

In wireless work such displacement loops are partly true Maxwellian (i.e. they consist of a pure etherial displacement in ether) and partly what one might call Lorentzian, or modified Lorentzian, because a portion of the loop path passes through the earth. That part which passes through the earth would be due to *electrons* according to modern theory, whereas the remaining part in the ether, or air, would only be due to electrons if the air was what is called *ionized;* otherwise the actual electrical displacement in the ether part of the circuit would have to be considered pure Maxwellian.

The difference apparently between a *Maxwellian ether particle* and a *Lorentzian electron* is that Lorentz's electron is supposed to account for the electrical conductivity in solids, liquids and gases or what is called ionization, whereas Maxwell's ether particle is supposed to account for the normal etherial conductivity.

ENGINEERING AS A VOCATION.

(*Continued from page 329*)

business men term it, for an insignificant sum. In some cases, however, the graduate, through personal or parental influence, finds his way into a berth *de luxe* in so far as financial considerations are concerned. The matter of salary is indicated in a general way from a table showing the salaries which may be expected after various numbers of years' service in practical engineering work, as published in a worthy volume entitled *Engineering as a Career* by F. H. Newell and C. E. Drayer. It appears that the average yearly salary amounts to from $1,200 (from one to two years after graduation) up to $5,000 per year, at a period of 12 to 15 years after graduation. Like every other rule, no matter whether it be of averages or quantities, there are exceptions. Among some of the shining lights in the engineering profession to-day may be mentioned that great master of pure physics and mathematics, Charles Proteus Steinmetz, a man who was evicted from Germany, due to socialistic tendencies, arriving in this country practically penniless, and who to-day commands the princely sum, for services rendered, of $100,000 a year. He is the chief consulting electrical engineer to the General Electric Company at Schenectady, N.Y. Mr. C. E. Scribner, chief engineer of the Western Electric Company, draws a yearly salary not a great deal smaller than this, while there are a considerable number of municipal or city engineers, as well as state engineers throughout the country who hold very desirable positions at salaries ranging from $5,000 and $8,000 per annum up to $30,000 and $40,000 per annum. It may be said that it is a case of hard work and study practically all the time, for those who wish to reach the top, and proverbially it seems that there is always room at the top for the right man.

THE TELEPHONE IN MODERN WARFARE.

(*Continued from page 369*)

ceptacle located on the side of the helmet; this jack is protected by a leather covering.

The various instruments used in this set are compact, and make an effective unit. It is extremely light and the inside of the helmet is covered with felt so as to make it comfortable for the wearer.

Although the present conflict is extremely injurious to the world in general, yet it has proven beneficial to the scientific world, in that it has caused scientists of all countries to develop and improve not only existing devices, but many new ones of great value in many ways and which will assuredly prove adaptable to many industrial problems to arise in the years of peace to come.

THE MARVELS OF MODERN PHYSICS.

(*Continued from page 330*)

light direct for illuminating purposes without the necessity of cumbersome conductors. He noticed five distinct forms of secondary discharge from his coil, controlled by a change in frequency or strength. Three were different forms of brush discharge; one a weak, sensitive, threadlike discharge, and one a powerful flaming discharge. Under certain conditions brush streamers issued from all parts of the coil, even through the insulation, while the brush in its hottest form resembled a jet of burning gas, giving off ozone freely. By stretching parallel wires across a room, a sheet of light may be caused to appear between them while an incandescent bulb or a vacuum tube would glow with a pale bluish luminescence if held near one pole of the coil. The effect of such a current upon air or gas is to alternately attract and repel the particles, setting them in exceeding rapid vibration, thus a large amount of heat is generated and luminosity occurs. Something of this condition, it is suggested, may explain some of the phenomena of the *Aurora,* and if such effects could be regulated over a large area of air space, storms and rains could likely be controlled.

There are a great many Tesla effects of wondrous and striking interest and of much scientific importance, with reference to artificial illumination. With a vacuum tube and a single conducting wire shown in Fig. 4, Tesla obtained a high degree of luminosity. If the filament inside of the tube was flexible it would often rotate in a circle as shown by the dotted lines due to its bombardment by air particles. Mr. Tesla himself believed that a new era of illumination would soon be entered upon, following the discovery that luminosity could be produced directly by the high frequency discharge, or indirectly, as in Fig. 5, with an unconnected tube within the influence of the electrostatic field. Less progress has been made in this direction than might have been expected, though the Moore lamp is of such a type. It is a long tube made to fit the room, and taking about .3 ampere at 12,000 volts. The color of the light is affected by the kind of gas present in the tube, and daylight itself may be quite successfully rivalled. A low efficiency and complication of details detract from the popularity of the light, however.

The latest use for light frequency currents is the production of a wave suitable for wireless telephony, and one of the best present methods for producing these currents is by the musical arc discovered by Duddell. He shunted a condenser and inductance around an arc light circuit and found that the condenser rapidly charged and discharged itself through the arc, setting up oscillations of great regularity and persistence. Such a simple arrangement gave a frequency of 10,000 per second. Valdemar Poulsen, by surrounding the arc with hydrogen and placing it in a magnetic field, obtained much higher frequencies—up to 1,000,000 per second, due to the cooling effect of the hydrogen and the tendency of the magnetic field to blow the arc. The waves sent out by such a device are of such high frequency and constancy as to permit transmitting the human voice with all of its delicate inflections.

This alluring field of high frequency currents, is *not* like many attractions, gilt on the outside only, but is solid gold. What it holds for us in the future we do not know, for achievements of the past are only a foretaste.

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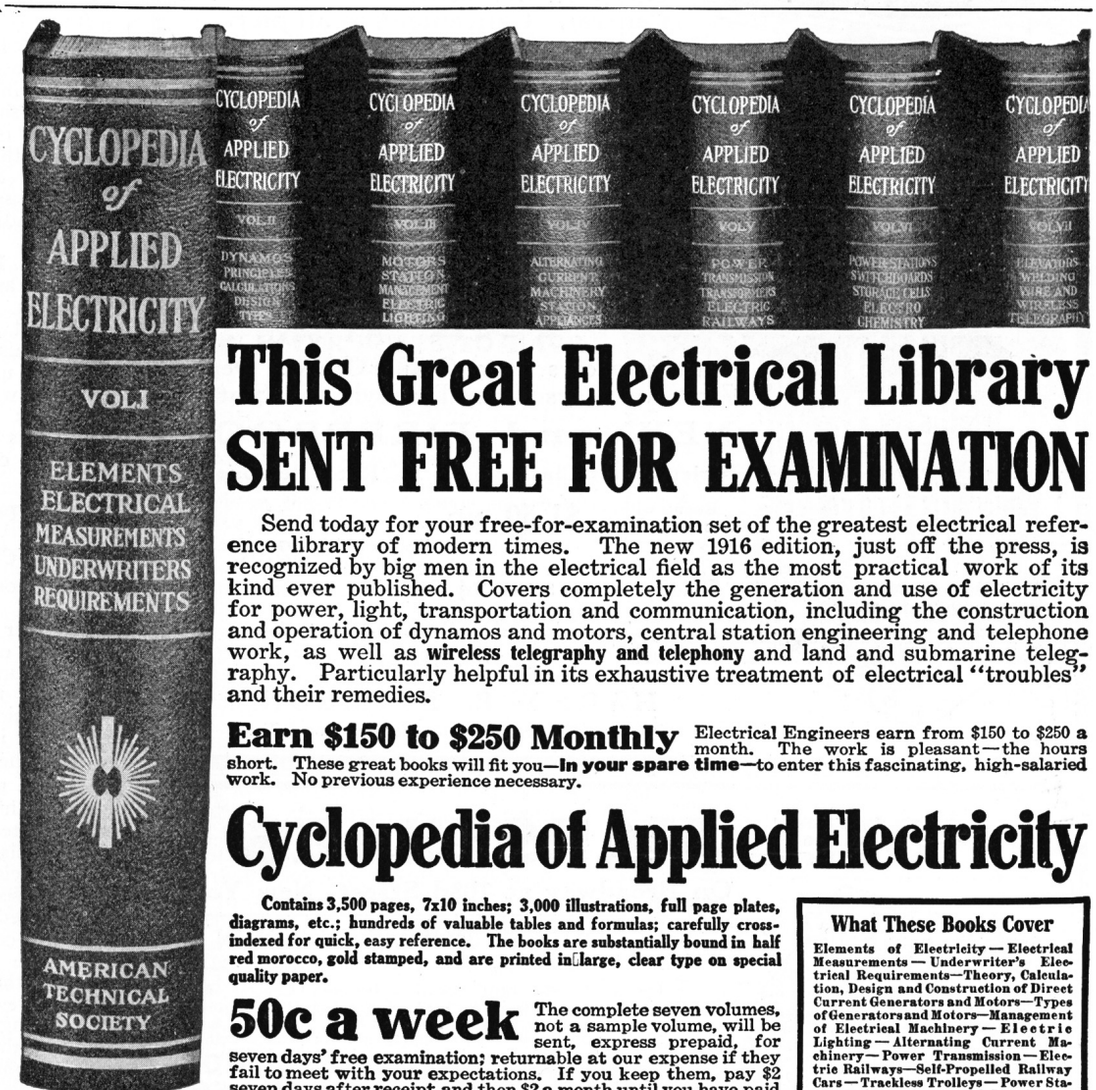

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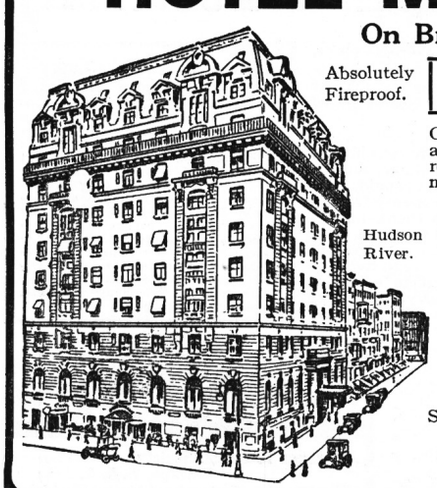

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NEW LIGHT WEIGHT RADIO SETS FOR AEROPLANES.

(*Continued from page 332*)

is used to tune the receiver primary. The secondary of the receiving tuner is of the untuned type which makes for simplicity and ease of operation, and is thought desirable as extreme receiving ranges are not necessary for aeroplane work. Variable coupling is provided.

The detector shown at the lower right-hand corner is of the floating crystal type. Silicon with an antimony point is used, on account of its ruggedness and ability to withstand strong signals. The 10-point switch at the left is provided so that additional inductance may be inserted in the antenna circuit to maintain a sending wave of 450 meters in case a portion of the trailing wire should be lost. The gap is mounted in the lower left-hand corner. When closed complete apparatus measures 8x8x7½ inches.

Fig. 4 shows a ½ k.w. transmitter panel. This set is somewhat more elaborate and heavier than the other. It is equipped with a 3-wave-length shifter, antenna transfer switch, 700-cycle volt- and ammeter, radiation meter, A.C. and D.C. line switches, generator field rheostat and measures 12x18 inches. The range on the set with an average ship's antenna is 200-400 miles. A number of these sets have been furnished for use on private yachts, but they are also adaptable for automobiles and for field use; it is expected that the Government will use this type of apparatus for aeroplane work, as the range under such conditions is far greater than that of any other set of equal weight now being built.

A MOTORCYCLE RADIOPHONE OUTFIT.

(*Continued from page 333*)

flexible conductors as indicated in the photograph.

Another very interesting thing about this portable outfit is the container in which the instruments are kept. This is built entirely of metal and so designed that the various side walls can be removed at will. Our first illustration shows the top opened so that the one in charge of the set can inspect the generating unit, including the engine, with ease. Another cover below this one protects the generating instruments. This is also shown in Fig. 1.

A special stand is provided to support the apparatus. When the instruments are to be used, it is removed from the chassis and the case is placed on it. The legs of the table are designed so that by merely forcing the complete unit into the compartment, they collapse and fold together thus permitting the complete outfit to slide into place with ease.

Undoubtedly outfits of this type will be very advantageous for Uncle Sam's signal corps in event of international conflict.

NEW YORK POLICE PASS WIRELESS TESTS.

Chief Inspector Max Schmittberger was informed by officials of the Brooklyn navy yard on July fourteenth, that three police lieutenants and five patrolmen had passed examinations at the training school for radio instruction at the navy yard and had been awarded certificates conferring on them the title of commercial radio operators of the first class.

The men were Lieutenants John A. Altenbach of the Atlantic Avenue station, Brooklyn; George H. Quackenbos of Headquarters; William H. Van Keuren of the East Twenty-second Street station and Patrolmen George Wolf, Emil Kopke, George T. Valentine, Michael C. Morney and John F. Murphy.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 343*)

crystal, we have caused gases to be given off, which condensed on the sides of the tube, and on the rod, forming finer divided crystals of the same substance with which we started, namely iodine. The process of Sublimation closely resembles Distillation, the distinction between the two being, that in Distillation, water was converted into a vapor, and then condensed to a liquid. In Sublimation the substance does not pass through an intermediate liquid state, but the solid vaporized, and the vapor condensed directly into the solid state. The product of sublimation is called a *Sublimate.*

CAUTION: *Do not allow any of the iodine crystals to come in contact with the skin.* To remove the iodine from the test tube, pour in a little alcohol, and shake thoroughly, being careful not to allow any to get on the skin, as it leaves a stain.

EXPERIMENT NO. 13—

DECOMPOSITION.

Put about 5 or 6 crystals of Lead Nitrate [$Pb(NO_3)_2$] into a perfectly dry test tube. By means of a test tube holder (Fig. 18) hold in the flame of a Bunsen burner for a minute or two.

[WARNING: Keep the tube pointed away from you, and do not hold your face over the mouth of the tube, as the crystals have a tendency to jump out of the test tube upon the application of heat. There is no danger attached, only be careful not to have your face over the mouth of the tube.]

After the heat has been applied to the lower part of the tube containing the crystals a short time, a crackling noise will be produced, and some of the solid will tend to jump out of the test tube.

Notice and record the color of the fumes which rise in the tube, as well as the color of the liquid which has formed in the bottom of the tube, caused from heating the crystals. Record any additional phenomena which you notice in the tube.

Decomposition is just the reverse of Synthesis, (Exp. No. 9) in that, in Synthesis we build up a compound from its elements, and in Decomposition we decompose or break it up into its elements, thus:

$$\underset{\text{(Compound)}}{Pb(NO_3)_2} = \underset{\text{Nitrogen Peroxide}}{2\,NO_2} + \underset{\text{(elements)}}{PbO} + \underset{\text{Oxygen}}{O}$$

Lead Nitrate — Lead Oxide

The elements Iron and Sulphur, were employed in synthesis (Exp. 9) to build up the compound Ferrous Sulphide, thus:

$$\underset{\text{(elements)}}{Fe} + \underset{\text{Sulphur}}{S} = \underset{\text{(compound)}}{FeS}$$

Iron — Ferrous Sulphide

The above reactions, as shown by the equations, should give the reader the methods of building up a compound, and breaking it up.

[WARNING: *Work this experiment near a window where a draught can be created, as the brown fumes contain Nitrogen peroxide, a poisonous gas. If worked in a draught there need be no fear. Of course, it is advisable to keep the tube as far away from you as possible.*]

EXPERIMENT NO. 14—

METATHESIS
or
Double Decomposition.

Dissolve about 1 gram of Lead Nitrate Pb.$[NO_3]_2$ in about 10 c.c. of water in a test tube. Dissolve about 1 gram of Sodium Chloride [NaCl] [common table salt] in 10 c.c. of water in another tube. The crystals when heated will dissolve much more readily. If the solutions are heated, allow some cold water to run on the lower part of the tube, after the substances have dissolved, in order that the solutions will cool rapidly. When both solutions are cool, pour one into the other and notice and record your observations.

Upon mixing these two solutions you will notice that a white substance has formed in the bottom of the test tube. This substance is called a *precipitate* which is caused by the Lead Nitrate and Sodium Chloride exchanging places. We started with two liquids, which manifested no appearance of containing any white solid in them, and by mixing the two, caused a white solid to form. This process of causing a solid to form by mixing two or more liquids is called Metathesis or Double Decomposition, and is used a great deal in chemical analysis, to determine the presence of various substances.

The visible product or *precipitate* which has formed is Lead Chloride, and the Sodium Nitrate has remained in solution, according to this reaction, the equation is:

$$\underset{\text{Lead Nitrate}}{Pb[NO_3]_2} + \underset{\text{Sodium Chloride}}{2NaCl} = \underset{\text{Lead Chloride}}{PbCl_2} + \underset{\text{Sodium Nitrate}}{2NaNO_3}$$

In Fig. 19 there is shown a cheaply made table rack for the Experimental Chemist. It will be found extremely serviceable as it is poor practice to have all kinds of acids and salts lying about indiscriminately.

HUDSON RIVER BOATS TO HAVE WIRELESS.

For the first time in the history of navigation, wireless is to be installed on Hudson River steamers. The Hudson Navigation Company has announced that the *C. W. Morse* and the *Berkshire,* the two largest vessels in the Hudson River passenger trade, have been equipped with Marconi apparatus and that the rest of the company's fleet would be similarly fitted if the new feature proves successful.

Land stations have already been installed at New York City, Poughkeepsie and Albany. Women operators, dressed in natty blue uniforms, will do the receiving and sending on the steamers.

The company was urged to install wireless on its steamers by business men who could not afford to be out of touch with shore for ten or twelve hours at a stretch.

In order to meet atmospheric conditions it was found necessary to lengthen the masts of both vessels and some experts declare that even now it will be difficult to operate the system when the steamers are in certain parts of the river where there are mountainous elevations on both sides.

The Hudson Navigation Company has arranged to serve its patrons with a general wireless news service which will include reports of New York and Brooklyn baseball games by innings.

NEXT "MAN BEHIND GUN" IS ELECTRICAL ENGINEER.

W. T. Snyder, newly elected president of the Association of Iron and Steel Electrical Engineers, says:

"When we have decided to make use of the vast amount of water power which is going to waste; when the waterfalls in the Rocky Mountains will help to roll steel in the Eastern States at the same time it is helping to grind wheat in Minnesota; when there will be universal application of electric energy even to domestic purposes; when the day that Dr. Steinmetz predicted will come and our country will be covered with a vast net-work of transmission lines—then the electrical engineer will be 'the man behind the gun,' for steam and many other forms of applied energy will soon be replaced by electricity."

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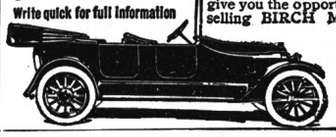

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E-VERYONE C-AN R-EMEMBER OHM'S LAW.

To remember Ohm's law easily says a writer in *Telegraph and Telephone Age,* arrange the three letters *C E R* (which indicate the electrical quantities), in the form of a triangle, as shown, remembering that *R* goes in at the "right" hand corner of the triangle. The positions of *E* and *C* can be readily recalled when we know that *E*-veryone *C*-an *R*-emember.

E

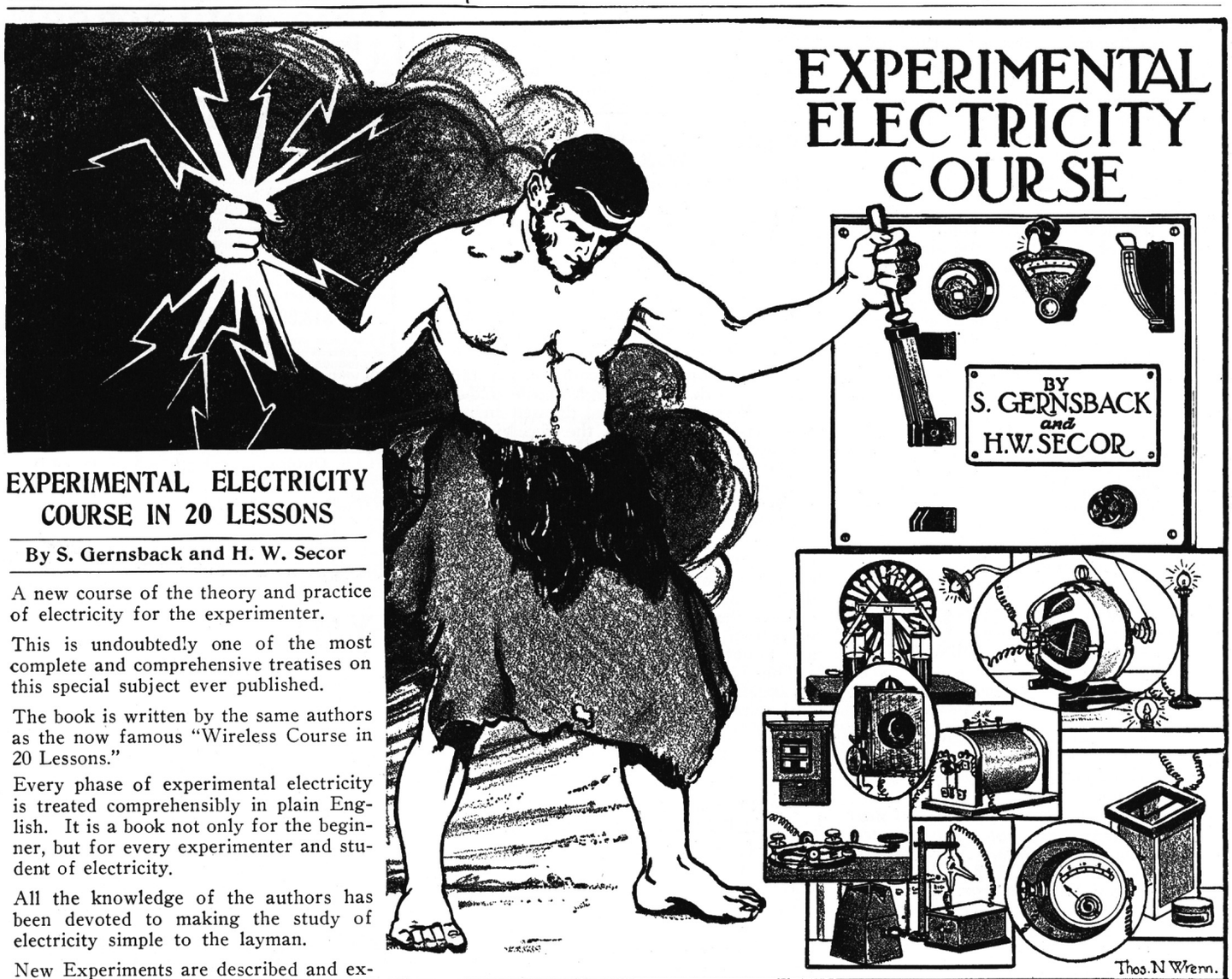
C R

In order to ascertain the value of any one of the quantities simply place a finger over the unknown quantity and the operation upon the other two quantities is indicated by their relative positions. Thus, for instance, to find the value of *E* cover that letter, which leaves *C* and *R* on a level, indicating multiplication. To find the value of *R*, cover *R*, thus leaving *E* over *C*, indicating division. *C* covered leaves *E* over *R*, also indicating division.

It is important, however, to use the formation of triangle in order to give the scheme a formula effect and impress upon the student a mental conception of the operation.

ELECTROLYSIS DAMAGE AT TRENTON, N.J.

The Water Department of Trenton, N.J., has recently tendered a statement to the City Commission showing that it is costing the municipality on an average of $2,000 annually to replace the water service lines on North Clifton Avenue. It is held that electrolysis caused by the system of the Trenton & Mercer County Traction Company on this thoroughfare is responsible for the damage, and that in some instances the large water mains also show signs of deterioration through this cause. Expert examination a few months ago showed that the electric energy escaping from the trolley lines was responsible.



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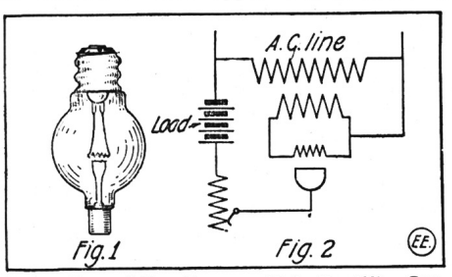
NEW ARGON FILLED GAS RECTIFIER.

From the first experimental work with electrical conduction through gases, a number of practical instruments have been developed. One of these is the Kenotron tube, manufactured by the General Electric Company. This tube, Fig. 1, is used as a half wave rectifier on high voltage circuits. It can handle currents of 250 milliamperes at a potential as high as 100,000 volts. Because of the large voltage drop, 100 to 500, it cannot be utilized on low potential circuits.

The glass bulb of this tube is three inches in diameter. The upper end is fitted to



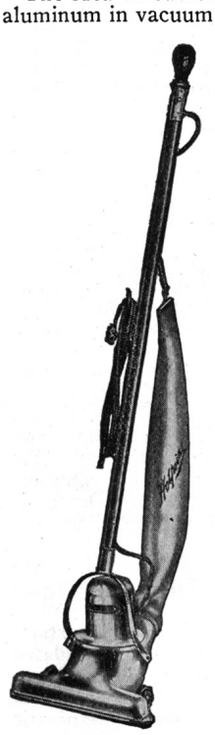
Connection of New Vacuum Tube Rectifier Containing Argon Gas.

screw into a socket, while the other end is formed as a contact for one side of the rectified current. A spiral filament, welded to heavy tungsten wires, gives off the negative ionic discharge. The anode, or large tungsten plate, is swaged directly from the lead which passes through the glass. Argon gas, at a pressure of 3 to 8 centimeters, cold, is used within the bulb.

Fig. 2 shows the connections of the Kenotron tube with a 40 watt transformer for filament excitation, a load, and regulating resistance. This method, however, is not as efficient as the full wave rectifier employing two bulbs. A special bulb has been constructed for this work, although two half-wave tubes can be used.

PRESSED STEEL ELECTRIC VACUUM CLEANER.

The idea of substituting pressed steel for aluminum in vacuum cleaners does not seem at first advisable, but this construction brings out a number of advantages over the usual construction. Because pressed steel is used, the case is made quite thin. Nickel plating is used as a finish, which is impossible on aluminum. The inside is perfectly smooth, so that no lint or dirt can catch there. A new ventilation system is used, which draws air from the top of the electric motor housing, through the armature, and out the lower edge of the case. Another point of construction is the central oil reservoir, from which all the bearings are lubricated.



MAGNETIC SURVEY ERRORS

Errors in existing magnetic charts to the extent of twelve to sixteen degrees have been found as a result of the work of the magnetic survey yacht *Carnegie*. This craft has circumnavigated the globe between parallels 50 and 60 degrees south.

ARE YOU LOOKING FOR NEW WORLDS TO CONQUER?

If you are falling short of interesting and worthy topics on which to write about or perform research work on, here is a list of a few mentioned as research subjects in the Proceedings of the American Institute of Electrical Engineers for May, 1916.

Radio Transmission.

Methods for producing damped oscillations for transmission purposes.

Methods for producing damped oscillations of particularly constant amplitude for laboratory measurement purposes.

Methods for producing undamped or continuous oscillations for transmission purposes.

Study of radio detectors

Study of radio amplifiers.

Study of the "beats" receiver and methods for producing oscillations for the same.

Comparison of "tikker" and "beats" receiver for the reception of undamped waves.

Advantages and disadvantages of using the "beats" receiver for damped waves.

Directive radio communication. Study of the variation of signal intensity with varying wave lengths. Methods of modulating the antenna current for radio-telephony.

Design of a compact portable decremeter.

Study of radio measuring instruments.

Design and construction of portable radio sets.

Design and construction of radio apparatus suitable for instruction and demonstration.

Modern theories of propagation of electromagentic waves (without mathematics).

Experimental determination of "radiation resistance."

Mathematical theory of radio transmission.

Miscellaneous Problems.

Agriculture, electricity in.

Amplifiers for weak currents and voltages.

Arc phenomena.

Automobile starting, lighting, ignition.

Atmospheric electricity, oscillograph study by means of an antenna.

Circuit breakers.

Electromagnets.

Farm lighting and power.

Fixation of atmospheric nitrogen.

Fuses.

Heating and cooking; heat accumulators; high-resistivity alloys; temperature control insulation.

Magnetic separation of iron ores.

Marine applications of electricity; electric drive of an ocen steamer.

Pictures, transmission of, by electricity.

Precipitation of suspended matter; smoke abatement.

Rectifiers, aluminum, cathode ray, mercury, revolving, vibrating contact.

Safety rules, standardization rules, and standard specifications of various associations in this country and abroad; a critical comparison

Submarine signaling.

Thermo-electricity, generation directly from fuel.

Telegraphy, rapid, multiplex, submarine with alternating currents.

Telephone apparatus for the deaf.

Telephone transmitters of great power; sensitive telephone receivers and relays; phantom circuits.

Water purification by electricity.

Welding, electric.

Our readers will no doubt realize that many rather ordinary topics appear in this list, but there is always room for more detailed investigation along these lines. Who will be the first investigator to chart the radiated wave forms occurring about a radio antenna?

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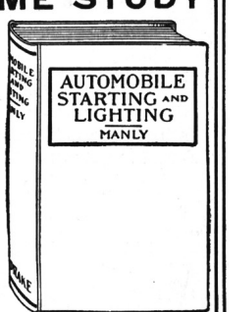

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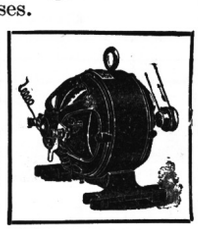

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How It Feels to Be in a War Submarine

THE engineer throws the lever and the submarine begins to submerge. We have all felt the helpless sensation when an elevator starts on a descent, and in the submarine, if we are to credit an account taken from the war diary of a German submarine commander and published in the New York *Evening Post*, it is exactly duplicated. What life is like when one is in the depths of the sea, or tangled in a net which the British have spread, or when mines and bombs are exploding all around, is told in part by this commander, who has kept a diary of events. This is how it reads:

Three minutes past six. Sunrise due in half an hour. Sea and sky a solid dead-gray. Horizon not visible and only to be guessed at. Our periscopes ceaselessly sweep the leaden obscurity. Sudden shock, as of electricity, tingles through me. Into the periscope's field of vision moves a black shadow. At first only a shadow, it grows, assumes a shape, a long, black hull; one, two, three, four funnels grow, like tree-trunks, out of the fog. A destroyer!

Submerge! The alarm sounds. Flood tanks! One leap into the conning-tower! The hatches come banging down over my head. The water roars into the tanks. Now for the torture of suspense, while, watch in hand, ticking off the precious seconds, I wait till the tanks fill and the old perfecto takes her time plunging. Longest seconds of my life! The destroyer, which wasn't more than 2,000 yards off to begin with, comes pounding down on us, putting all her 40,000 horse-power heart into the business. Her bow guns are as busy as sheet lightning of a hot summer's night.

"Donnerwetter! If he only doesn't get us this time." One bull's-eye, and it's all up with the undersigned. Thank God, I hear the water tickling the little panes of glass in the lookout of the conning-tower. But I can see the monster's shadow swiftly moving across the ocean's surface. Like a hammer-stroke on an anvil, his shells burst around us. Devil take the fellow, he's getting our range! Another try, and he wins the cigar. But just then daylight fades away, and darkness closes down on the lookout windows like a solid shutter. The oldtub obeys her rudder and wiggles down under the water.

The mellow light of electricity now wraps us comfortably about like a new woolen blanket. The manometer's indicator registers the following depths: eight yards, nine yards, then ten, and finally fourteen. Saved! Really there's no sensation like this of being buried securely in the depths of the sea. Our trusty perfecto keeps right on on the downward path, beautifully sensitive to bow- and stern-rudder, which are the bridle and spur of a reliable submarine. Twenty-four yards, twenty-six, announces our honest manometer. I've told them to keep right on going down till they register thirty yards.

Way up yonder, somewhere on the ocean's roof, we can still hear the Frenchman angrily gesticulating and spitting fire. Much good may it do him!

We were heading downward. The manometer registered seventeen yards. Suddenly something hit us, knocked us on the head, and sent us down and out. We might as well have been hit over the skull with a belaving-pin. When we came to, we were lying scattered about in various picturesque attitudes, holding our bruised heads and shoulders. The boat was trembling and shaking like a nervous horse. The lights had gone out and left us groping.

"The safety-switch!"

"No use. She has gone dead as a doornail."

"Try the reserve battery!"

And then suddenly daylight switched on once more.

What was up? Why weren't we done for? Why didn't the ocean come cascading in on us and nail us to the bottom? There is no question but that we had hit a mine and sent it off with a terrific bang. From all quarters now came shouts of "Bow all tight and shipshape; starboard and port tight as a drum; stern free and clear!" But at this moment the ship began to lurch downward; bow down, stern up. She was practically standing on her head.

"Something wrong with the steering-gear, Cap," shouted Lieutenant Gröning, who was at the wheel. "She doesn't mind her rudder as she ought. We've got caught on a rope or in a net."

"Himmelkreutzdonnerwetter! We were just wanting that on top of everything else. Here we are neatly netted, with a string of mines, no doubt, just overhead. There's nothing to it."

"Look sharp," I shouted. "Keep her headed down, full speed on! Don't let her come to the top. There are mines up there."

The engines started humming, the ship butted forward into the net, boring, ripping, and tearing as she went, and finally rent the steel trap to shreds like so much mosquito-netting.

"Three cheers," shrieked Gröning, out of the ship's bowels, "we're through. She steers as easy as a bicycle."

"Down you go," I ordered. "Try for fifty meters." What had happened was this: When we hit the net the shock must have set off some fuses which in turn exploded the mines woven into the upper portion of the net. These mines were so placed that they would have caught a submarine cruising along near the surface in the usual way. Had we tried to attack the destroyer, or for any other reason kept within striking distance of the upper world, we surely would have landed in the net exactly as our friends the enemy planned, so as to hit and explode the mines directly. As luck would have it, we dived, and the mines exploding far above us did no further damage than to scare us stiff and decorate the old hulk with a few new beauty-spots.

Surely the Frenchmen up yonder must have embraced and kissed, as is their custom, all around when they heard and saw that terrific explosion; no doubt they wirelessed the glad tidings at once, "Enemy submarine caught in net and destroyed by mines." Well, we didn't grudge them any of their chuckle, if only they would let us alone for a bit. I admit we had had enough for the time being.

But even more exciting was an encounter with a trawler, one of the fringe of the British fleet sent out expressly to dispose of some of the troublesome submarines. The U-boat had been sighted and the trawler sped forward on a death-dealing errand. She was as relentless as Death itself, and, it seemed, as inevitable. The submarine captain writes:

"The fellow's crazy," I shouted. "He wants to run us down. Full speed ahead! Hard 'o port!"

But it almost looked as if we'd got started too late. The trawler had accumulated momentum enough to better us considerably in the matter of speed. She came at us, panting and growling like an asthmatic old bulldog. The original interval of two hundred yards that separated us was getting uncomfortably less and less. Her foam-showered bow towered above us scarcely fifty yards away.

In true proverbial fashion, the hair on

our heads was beginning to get restless under our headgear.

"Pistols and rifles this way," I shouted, from the conning-tower. No sooner said than done. We now opened fire on the rapidly approaching monster. I could already see the watery-blue eyes of her enemy captain light up with fiendish glee in the seamy waste of his weather-worn face. Closer and closer they came, nearer and nearer moved the steel cliff of ship's bow. I felt like part of my ship, and the anticipation of the blow was like a knife-edge in my back.

Twenty yards, fifteen! Wasn't there any way out? Surely! Gröning, the trusty, came to our rescue. He was kneeling on one knee, sending shot after shot into the trawler. Suddenly he switched on a bright idea, like an electric sign of a cinema at nightfall in Unter den Linden:

"Everybody aim for the man at the wheel."

In the little mahogany steering-tower, with windows all around him, like a manikin in a show-case, stood the helmsman of the *Ormea,* carefully selecting a soft spot in my turtle-back to land on with his bow-point. We could see him as plainly as if he were on the inside and we on the outside of a store-window.

Gröning's bright idea got us all busy on the instant. We quit aiming at the oncoming bow, which didn't object to our attentions at all, and concentrated on this one man. Our volley of shots rattled out noisily. From across the way came an almost simultaneous cry. The Englishman threw his hands up, fell forward across the wheel, which whirled about at the instant of release.

Slowly the juggernaut bow veered to one side, but ripped by so close that in passing she side-swiped us, and left us with the souvenir of a dented water-tank.

DIRECTIONS FOR DESIGNING, MAKING AND OPERATING HIGH PRESSURE TRANSFORMERS. By Prof. F. E. Austin, B.S., E.E. 46 pages; 21 illustrations; 7¾x4¾. Cloth covers. Price, 65 cents. Published by the Author, Hanover, N.H.

This little volume is a brief but valuable treatise for those interested in the construction of high-tension transformers.

The author tells in plain language how to calculate and obtain the various dimensions for different sizes of closed core high voltage transformers for use on any ordinary low-tension circuits. The copper and iron losses and their usual values are explained; also the method of calculating them. A table of the loss in watts at 15, 25, 60 and 100 cycles frequency for a cubic inch of transformer iron is given. An example is given for the calculation of a 20,000-volt, 1 kilowatt, closed core transformer, for use on a 110-volt, 60-cycle circuit. Suggestions are offered on the manner of assembling the iron core laminations, and the sectional secondary method of construction is illustrated in detail. The possibilities of a transformer being used as a frequency changer are mentioned, as well as the method of connecting primary coils to produce different secondary potentials.

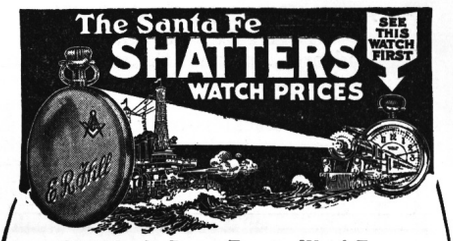
ROMANCE OF REALITY—ELECTRICITY. By W. H. McCormick. Cloth bound, 8¼x6 inches; illustrated by photographs and drawings; 293 pages; price, $1.50. Published by Frederick A. Stokes Co., New York.

Those who have only a superficial knowledge of electricity will find this book of interest, as it explains, in a popular way, the different applications of electricity. The apparatus described is of British construction, for the most part, but the devices differ little from those in use in America. Almost every subject is discussed, from atmospheric electricity and magnetism to industrial electrolysis and electro-culture. There are two particularly good chapters on the English telephone systems, and an interesting account of the use of wireless in the European war.

MARCONI COMPANY PROFITS.

The Marconi Wireless Telegraph Company of America announced recently that the ordinary general meeting of the Marconi Wireless Telegraph Company of England was held in London June thirtieth, and that the profit of the latter company for the fiscal year, closing December 31, 1915, amounted to £377,000. (One pound equivalent roughly to $5.00 American money.)

The directors recommended a final dividend on the ordinary shares of five per cent. The amount carried forward to profit and loss, according to the cablegram, is £307,000.



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21 JEWEL "Santa Fe Special" $3.50 A Month

Write for **FREE** watch book today, it shows newest case designs in 4 colors. Read the so-called secrets of watch making. Read how you can save from one-third to one-half of your money. Order "Direct." Save the Profits of the Wholesale Jeweler. Buy the BEST RAILROAD Watch, the one "That's Guaranteed for Life," thin model, all sizes, adjusted to positions, isochronism, temperature and to the second.

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SANTA FE WATCH CO., Dept. 929, Topeka, Kansas

HI-PO
WATERPROOF DRY CELLS

And Ready for Use CONNECTED SETS

Highest quality and absolutely protected against moisture, dampness, fog and spray. Give 100% service even when standing in water.

Set of 4 cells (5 volts) **$1.60**

Set of 6 cells (9 volts) **$2.40**

Other sets in same proportion

The only guaranteed and original waterproof Dry Battery.

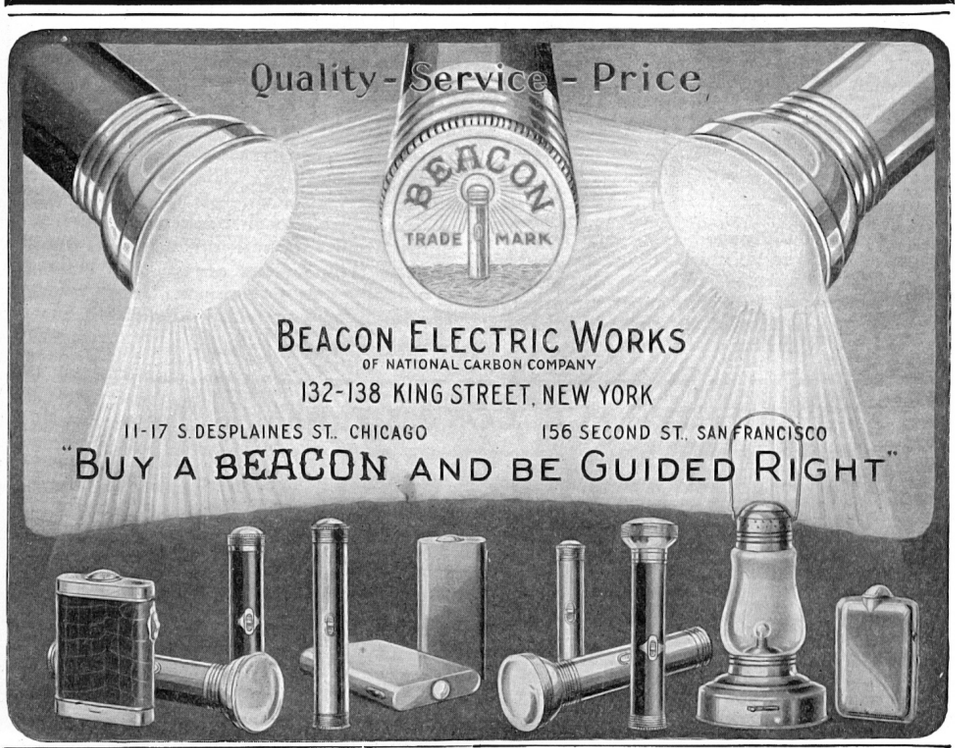
Beware of Imitations.

If your dealer does not handle our goods, send us his name with your remittance.

No. 6 Cells **35c.** each

HI-PO Waterproof Battery Company

1007 Atlantic Avenue, Brooklyn, New York



A TRACKLESS-TROLLEY BATTERY CAR.

In Bradford, England, the general manager of the municipal city tramways has shown not a little ingenuity in converting an old electric trackless-trolley car into an electric truck. At the present time the vehicle makes use of the overhead-trolley current supply while traveling along the tramway route, and by means of a storage battery which it carries it is enabled to leave the route and travel a distance of several miles on the stored-up current. But one trolley wire is used, the return circuit being effected by a grounding device in the form of an extension of the steering arm, terminating in a contact shoe bearing on the track. The trolley-supply voltage is 500, and that of the battery but 150. However, the latter is found sufficient to drive the car at a slow speed while journeying away from the tramway route.

Refer also to an article on "Transcontinental Electric Autos" in the July, 1916, ELECTRICAL EXPERIMENTER.

OBITUARY.

J. Frank Morrison, aged seventy-six years, one of the foremost electrical men in the early days of the electric light, and an old-time telegrapher, died at Baltimore, Md., July third. He was for many years manager of the Western Union office at Baltimore, and was one of the most prominent politicians in Maryland. He reorganized the police and fire alarm systems in Baltimore and placed them on a sound footing. He was president of the famous Crescent Club of that city, the political stronghold of Maryland. He was also president of the Southern Electric Company and the Brush Electric Company and the National Electric Light Association. During his career he made and lost many fortunes.

Electrical apparatus by which all the movements of a ship can be controlled from the bridge without signaling to the engine room has been invented by a Japanese.

WITH THE AD MAN.

I have been wondering since we got out our July issue with its important announcement of the increase in price of THE ELECTRICAL EXPERIMENTER from ten to fifteen cents, if you appreciate how much the advertiser is doing to help the publishers out in these strenuous times, when costs are rising over night. Our advertisers have gallantly come to the aid of your magazine by taking larger space, in the hopes that the additional revenue will tide over your monthly visitor until times are again normal, for after all, my friends, while your price has been increased five cents per month, it is the advertiser who pays the "freight." It is to him that we must look for the real revenue that pays our enormous paper and printing bills. He is spending his good money to introduce to you his products, services or books, as the case may be. He is entitled to your support. He not only wants you to read his ads and be interested, but he wants you to send for his literature and when you are in need of what he advertises, he expects, and very rightfully expects, that you will patronize him. Every advertiser in THE ELECTRICAL EXPERIMENTER is an actual supporter of the magazine. If it were not for the advertisements, the magazine could not be published. I know that in the past you have patronized our advertisers. Now I want you to do more. When you hear of anyone who needs anything advertised in THE ELECTRICAL EXPERIMENTER I want you to take your copy of the magazine over to him and be a real booster for the advertisers in your magazine. It is not hard—costs you nothing and will make for a bigger and better ELECTRICAL EXPERIMENTER.

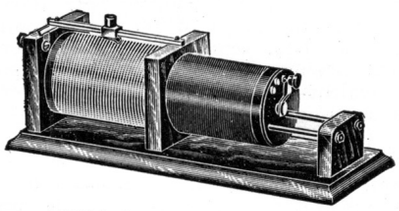
Can I count on your support?

MILTON HYMES.

"Preparedness"

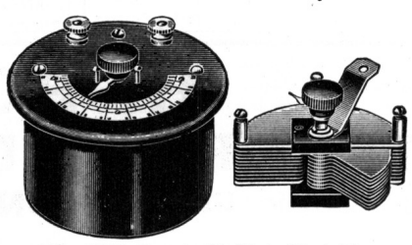
In War or Peace

Use Bunnell Apparatus



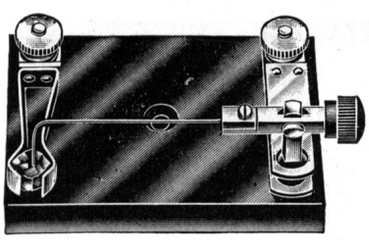
No. 8833 Dandy Loose Coupler $6.00

Best and most durable. Up-to-date dealers have them in stock.



No. 8654 Dandy 21 Plate Variable Condenser $3.75

Our Catalog 36E illustrates and describes about 300 articles of wireless apparatus as well as other appliances. Send 2c. stamp for it, to



No. 8804 Jove Crystal Detector Holder
On Dark Porcelain Base . . . $1.25
On Handsome Composition Base . . . 1.50

J. H. Bunnell & Co.'s

Radio Dept.

32 Park Place New York

ACCEPT THESE BOOKS FREE

These two, 100 page books, each containing from 88 to 90 illustrations, are sold by us regularly at 25c. a piece.
In connection with this most remarkable offer you can now get them ABSOLUTELY FREE, for a *very limited time.*

Since we published these two books last January, over 6000 of each have been sold. If you are a wireless experimenter, yon can ill afford to be without these two latest authoritative works, published by the one concern in America, that knows what the "How-to-make-it Fiend" really wants. In these two hand books are concentrated the most important, up-to-date wireless instruments and directions how to make them. They are by far the most successful wireless books of the season. Size of each book is 5x7 inches, substantially bound on a good book paper. The covers are in two colors. We really can not praise these works too highly. You will be delighted with them.

EXPERIMENTER PUB. CO., 233 Fulton St., New York

Gentlemen:

On your absolute guarantee that your two big Wireless Handbooks are just as described by you, you may send me same *FREE.* All charges prepaid. You are to send me these books at once, and enter my name for a full year's subscription to the *Electrical Experimenter,* 12 numbers, for which I enclose *$1.00, the price of the Electrical Experimenter alone.

(If a 2-year subscription is desired, enclose $1.85.)

My name is.....

My address is.....

(9) *Canada and Foreign Countries, $1.50—2 years, $2.85.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 70,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Two cents per word* (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 30c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the October issue should reach us not later than August 28th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 70,000 PEOPLE READ THIS JOURNAL

EXCHANGE—Large motion picture machine and equipment for cabinet audion receiving set. Box 3, Highwood Station, New Haven, Conn.

FOR SALE—12 volt, 3 ampere generator, $3.00; loading coil, $1.00; lightning switch, $1.00; ¾ inch spark coil, $1.50; bicycle equipped, $12.00. Thomas Hicks, 425 West Miner St., West Chester, Pa.

LOOK HERE—Ferron detector, $3.00; Galena detector, 25c.; 1,500 coupler, $2.50; 2 fixed condensers, 50c. each; No. 364 Murdock condenser, $2.00; No. 365 Murdock condenser, $3.50; Studebaker self starter, $20.00; Murdock loading coil, $2.00; Blitzen receiving set, $18.00; Audion bulb with "B" battery, $7.00; rheostat, 40c.; Brandes phones, $4.00; wanted—two commercial keys and a storage battery. Herman Staab, Ironton, Ohio.

WILL TRADE $60.00 audion receiving and ¼ K.W. sending set for Smith motor wheel. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—One cylinder automobile gasoline upright, water cooled, seven horse power, complete with coil, carburator, crank $12.50. Clarence Vaughan, Middletown, N. Y.

MANHATTAN LOOSE COUPLER—Murdock detector, Murdock loading coil, condenser, 500 ohm receiver headband cord, telephone magneto, telegraph set, ½" coil, good condition. $8.00. Rothman, 106 Ross St., Brooklyn, N.Y.

WANTED—Omnigraph No. 2, Junior, will pay cash. State lowest price. R. P. Krajick, 1921 Lorain Ave., Cleveland, Ohio.

FOR SALE—Two Audions, headsets, spark coils, books, variables and experimental apparatus. Send for price list. Correspondence solicited. Louis Hasbrouck, Amherst, Mass.

FOR SALE—⅛ H.P. motor, $6 receiver and headband, 50c., 1 inch spark coil $3.00. Carl Henkelmann, 634 A. St., Lincoln, Nebr.

FOR SALE OR EXCHANGE—One small receiving set $2; one medium receiving set $5; aerial, five wire, fifty feet long, sixteen insulators, $2; two small telephones, work up to ten miles, cost $12 sell for $5; pair of spiked $4 baseball shoes, new, sell for $2; pair boxing gloves, new, cost $4.50, will sell for $2.25. Paair hickory skis, 7 ft., cost $4.50, sell for $2.25; hickory bow, 5 ft., $1; small concert outfit $2; copies of Scientific American, Technical World, Popular Mechanics, Physical Culture, Saturday Evening Post, Adventure, American Photoplay, Motor Age, Adventure, American Boy, Youths Companion, one copy of Harper's Outdoor Book for Boys, $1. I want pastel crayons, Savage repeater, or automatic twenty-two; good books, by such authors as O. Henry, Kipling, etc; copies of adventure or Argosy; Auto harp or Ukalele, kodak, revolver, tennis racquet or fish rod. Write me. L. H. Sargent, Abrams, Wis.

FOR SALE

100 watt transformers, closed core wax impregnated and boxed. Built for firm that has gone bankrupt. Primary 110 A. C. and give ⅜" flame. Price, $2.35 each. Satisfaction guaranteed, wt. 15 lbs. Also limited quantity genuine polished Italian marble panels 14 inches long x 8 inches wide x ⅜ inch thick, beveled, easily drilled; guaranteed brand new, weight 5 lbs. Price 95 cents each. L. R. Jewett, 200 Lewis St., Lynn, Mass.

WE ARE Middle West agents for the Electron Relay. Avoid delay. Order from us. Blue prints of new easily made coupler, 25 cents. Ironton Radio Sales Co., (not inc.) 510 S. 7th St., Ironton, Ohio.

$50.00 AUDION type detector and Premo film pack camera complete with outfit; Edison phonograph and set of Encyclopedia Britannica for sale or exchange. S. Winat, 8-10 E. 107th St., New York City.

COMPLETE WIRELESS sending and receiving set, cost $29.00, will sell for $20.00. George M. Seeger, 401 N. Charles St., Bucyrus, Ohio.

WANTED—Complete wireless outfit, preferably sending and receiving, but would take receiving only. Must be good and cheap for cash. Joseph Haskell, 60 Congress St., Boston, Mass.

1 H.P. ELGIN gasoline engine in good shape. $19.00; 6 volt Knapp dynamo, $2.50; 6 volt $8.00 K & D dynamo, $5.00; 1 pair E. I. Co. No. 6666 phones, $6.00; 1 loading coil, $2.00; tuning coil, $1.50; detector, $1.00; three buzzers, 20c. each; glass, $3.00; Expo watch camera, $2.00; dynamo for $40.00 blasting machine, $8.00; ¼ spark coil without vibrator, $1.00; Crystaloi O new, $2.75; Ajax motor, 75c.; strap key, 25c. All above articles in good working shape. M. Eakle, New Hope, Va.

WANTED—To buy or exchange wireless, electrical and athletic goods. Give particulars. Wayne Wagner, 18 East St., Ashtabula, Ohio.

DO THESE "ADS" PAY?

Mattoon, Ill., June 26, 1916

Dear Sirs:

Talk about results!! I never expected *my little apparently insignificant ad* would bring results, but believe me I have received so many letters and such good results I am convinced that advertising in "E. E." brings results superior to all others.

Yours Cordielectrically

PAUL J. McGEE,

Secretary, Mid-West Radio Relay League.

FOR SALE—A $25.00 course in writing the photoplay. Rare bargain, $18.00. Ray Berg, 613 Union St., Champaign, Ill.

FOR SALE—½ H.P. vertical air cooled 2 cycle stationary gasoline engine, $6 cash, without accesscries. Fisher Ames, Massena Springs, N.Y.

FOR SALE—One Stevens 22 repeater used 6 months, $6; and one Stevens Ø2 single shot in fair condition, $2. Benj. McCaul, Ayr, No. Dak.

WANTED—2 variable condensers, 43 plates with or without case, lightning switch, fixed condenser. Pay cash or exchange for Edison phonograph. Vandell, 328 6th St., Brooklyn, N.Y.

FOR SALE—$14.00 electric locomotive and track, $10.00 or trade for Brandes Navy phones in A1 condition. Locomotive is running finely. $5.00 movie machine, been used once, $3.00, or trade for instant radiograph. $1.00 Daisy air rifle with broken sight, 50c. George Dimon, 367 Genesee St., Utica, N.Y.

SALE OR EXCHANGE—1 set, 3 vols., covering I.C.S. draftsman's course, make offer. A. I. Darnall, Searcy, Ark.

FOR SALE—1,000 meter coupler, $3.00; electrolytic detector, 75c.; condenser, 35c.; ½ K.W. transformer, $8.00; 2 magneto desk telephones, $6.50 each; watchcase receivers, 30c.; 3,000 meter loader, $1.50; telephone transmitters, 70c.; Thordarson toy transformers, $4.00, type S motor, $3.00, 2 volt, 40 ampere storage, $1.50. What have you? Hester Little, South St., Lockport, N.Y.

FOR SALE OR EXCHANGE—5x8 brand new printing press and complete outfit, including 4 fonts of type. Bargain. R. C. Arnaud, Keene, N.H.

FOR SALE—Interstate receiving outfit used three months, $3.00; 1,000 ohms receiver with headband, $1.90; collection of 575 precancelled stamps, $4.50. Harold Booth, Belcherttown, Mass.

BLITZEN radiocoupler, $5.00; 2,000 ohm headset, $4.50; brass key, $1.50; DeForest audion bulb, $2.00; loose coupler, $4.75; pancake oscillation transformer, $4.00; phonograph with records, $4.50; Robert C. Bishop, 413 Locust St., Lockport, N.Y.

EXCHANGE—Lot of goods; want typewriter, gasoline engine or storage battery. Write for list. Frederick Towns, Marlboro St., Keene, N.H.

FOR SALE—Large 20,000 meter coupler, $12.00. Send for list of other wireless bargains. Charles Roberts, 2051 N. Lawrence St., Philadelphia, Pa.

WANTED—Navy loose coupler. Have other articles to trade for wireless instruments. Brewton Berry, Orangeburg, S.C.

WILL EXCHANGE $25 Ransomerian penmanship course for first-class high range wireless receiving apparatus. Joseph J. Schiller, Oenaville, Texas.

SACRIFICE—First $6.00 gets 1-inch coil, 1 spark gap, 1 electrolytic interrupter, 2 one quart Leyden jars, 1 extra heavy ½ K.W. gap, R. W. Hoffman, 4011 Greer Ave., St. Louis, Mo.

FOR SALE OR EXCHANGE—$18.00 White Cross vibrator for 110 A.C. and D.C. current, like new. Want Victrola. Also $10.00 electric mirroscope for best offer of cash, camera, electrical goods or what? K. Bard, Manawa, Wis.

FOR SALE—Wireless apparatus, key and sounder, Kodak tank. Want Omnigraph or what have you? Will sell for cash. Thos. Shay, 768A Quincy St., Brooklyn, N.Y.

FOR SALE—Two 8-inch spark coils; two ¼-inch coils, telephones, lathe, emery wheels, tools and tool chest, helix and tuning coils. F. E. Austin, Hanover, N.H.

QRX: CAN U USE—Radio Apparatus Company's rotary gap, $9.65; Blitzen ¼ K.W., $9.40; Murdock oscillation, $3.00; Holtzer-Cabot phones, $5.95; 30 ampere key $1.00; Navy coupler parts, fibre, $2.45; lightning switch, $1.50; ¼ K.W. gap, 35c.; step-down transformer, $3.00. Write immediately. All letters answered. C. R. Barnickol, 2317 Milwaukee Ave., Chicago, Ill.

FOR SALE—6 H.P. water cooled gasoline engine, suitable for cycle-car, $25.00; 9-inch lathe castings (nearly finished), $30.00; small photo for red stamp; two bridging phones (one minus magneto), $8.00. Liberal discount if sold at once. Blue prints for lathe extra. Morse Lloyd, 1405 Ninth St., Portsmouth, Ohio.

EXCHANGE—Edison phonograph, 85 records. Want screw cutting lathe or 1 K.W. transmitting set or 110 volt 9 ampere D.C. generator. Lysle Tatro, Castalia, Iowa.

FOR SALE—Complete transmitting outfit, ½ K.W. Blitzen transformer with primary switch for regulation of power, Murdock condensers, Murdock oscillation transformer, Radio Apparatus Company Marconi style rotary spark gap with rheostat for regulation to 6,000 R.P.M., Eck rotary converter, starting box, aerial switch, key, etc. Make offer. Also have receiving set for sale. Paul C. Elliott, 162 E. 66th St., New York City.

FOR SALE OR EXCHANGE—Cornet, Lyon & Healy, "Own Make" duplex silver plated, gold engraving, value, $35.00. Also an L. C. Smith No. 2 Typewriter in first class shape, recently overhauled, works and looks like new machine. Value, $25.00. Will exchange for wireless receiving outfit or for high power prism binocular. E. V. Wilson, Archer, Wyo.

EXCHANGE—Dyke's Home study course of automobile engineering for motorcycle or wireless set. Ernest Becks, Palatka, Fla.

FOR SALE—Crystaloi Type "O," $1.75; ½-inch coil, $1.50; 4 tuners, 50c. each. John W. Carroll, McComb, Miss.

HAVE PACKARD aerial switch, heavy key, quarter horse-power motor, medical coil, pancake helix, Radioson, Ferron detectors, impedance coil, American model builder, telephone transmitter, receiver, coil, pony receivers, telegraph; want Flexible, Arlington tuner, Murdock oscillation transformer, moulded condenser and cash. Harold Long, 912 Ind. Ave., LaPorte, Ind.

FOR SALE—1 Mandelette minute camera, complete with 35 post card films, $2.50. L. J. Becker, 2924 Avenue L, Galveston, Texas.

WANTED—Good, cheap, second hand spark coil, 2 to 4 inch capacity, first-class condition. L. E. Adams, Rosedale, Ind., Box 41.

MOTORCYCLE—1913 Indian, clutch, magneto, new tire, fully equipped, excellent condition. Also $10.00 drafting instruments. Will trade for good make of wireless goods. Sam Frizzell, Duxbury, Mass.

ELECTRON RELAYS, amplifiers and oscillators, new, have several and will trade for radio apparatus of all kinds. What have you got? B. Benedict, 1530 San Pablo Ave., Oakland, Cal.

FOR SALE—Two Navy type loose couplers, 3,000 meters, $8.00; 1,000 meters, $4.00. Trade for 6 volt storage battery or Radioson Detector. R. E. Shumaker, Galion, Ohio, R.D. 2.

FOR SALE—Complete wireless set, cost $65.00, sell for $30.00. Reason for selling, going to college. Information regarding set sent on inquiry. Miles F. Ham, Box 437, Augusta, Me.

REPEATING RIFLE—22 cal. special Winchester (W.R.F.), almost new, price, $8.00, worth $10.00. Ernest Machander, Santa Ana, Calif.

FOR SALE—5 ZH, my very efficient 1 K.W. Clapp Eastham complete transmitter, practically new. My time signals have been copied eight hundred miles. First check for $125.00 takes it. W. O. Horner, Jeweler, Cleveland, Tenn.

FOR SALE—One type RJ9 audion detector, one filament good, other no good, been in use one month, price, $10.00. Philip Bost, Box 86, Statesville, N.C.

BARGAIN—Have a 110 volt D.C. 8 inch Sprague electric fan and a Bunnell 150 ohm telegraph sounder with sensitive adjustment, never used. Will exchange for audion in good condition. J. Greiner, 2730 Decatur Ave., Bronx, New York City.

FOR SALE—Fixed, high tension and variable condensers, Brandes 2000 ohm receivers, spark gap, Geissler tube, 3 inch spark coil, ⅜x¼ inch silver pointed key, storage battery, unfinished coupler, all for $25.00 cash. John Raynis, 498 Meetropolitan Ave., Brooklyn, N.Y.

FOR SALE—1½ K.W. Commercial type Edgecomb-Pyle Wireless transmitting set, complete, in perfect condition. Also Murdock receiving transformer, oak cabinet, etc. Write me quickly for BARGAIN price and description of this apparatus. H. W. Snyder, Montfort, Wisconsin.

DYNAMO—For Sale with self-oil bearings, 34 in. shaft, 6 in. width and 4 in. diameter of pulley, 30 amperes, 90 volts, suitable for electric furnace or arc lamp, $65.00. Write Carl Bailey, Box 153, Baltimore, Md.

I.C.S. Complete Course in Electrical Eingineering for sale, also 5x7 Seneca No. 8 Camera. Best offer. J. R. Denkhoff, Dyersville, Iowa.

FOR SALE—10 inch double slide tuner, $1.50; 2000 ohm head set, $2.50; ½ inch wireless coil, $1.50. Will trade part for a 43 plate Blitzen Variable. Jack Gillette, Purcell, Okla.

FOR SALE OR TRADE—Gernsback Variable, Electro Amateur Phones. Home made tuning coil 300 meters, detector, buzzer, all new. Sell all $8.00 or separately. Want Brandes 'Phones; large tuner; loose coupler. W. H. Pendell, Vida, Oregon.

SALE—Brand new $27.00 Thordarson Wireless Transformer, 1 K.W., latest model, with kickback preventer, $23.50; $6.75 1 K.W. Oscillation Transformer, brand new, $5.50 or trade for two good 43 plate variables. $13.00 Motsinger ignition dynamo, $9.50. 2 in. sending condenser, 35c. or trade for D.P.D.T. switch. James Wilson, Box 514, Stromsburg, Neb.

EXCHANGE—$5.00 Steam Engine for 3000 ohm Phones. Reversible motor for steel 3 section tripod. Glenn Kruwell, Hubbard, Iowa.

FOR SALE—Must sacrifice my 110 volt A.C. D.C. rotary converter which I am now using for lighting purposes and wireless work. $35.00 will take it. Shipped on approval to parties of good reference. Emil Roth, Castle Shannon, Pa.

SELL—Receiving transformer, tuning coil, loading coil, Crystaloi detector, Vest Pocket Kodak, relay. Raymond Roof, 198 Fremont St., Battle Creek, Mich.

8ARE HAS FOR SALE—The following instruments, all in excellent condition. R. J. 9 Audion with bulb, $12.50. 75 ohm phone, 25c Jove Detector with galena, 75c. New $3.00 Murdock Loading inductance, $2.00. Baby blow torch, 65c. R. J. 5 Audion with bulb and high voltage batteries worth $18.00 at $14.00. Halcun, rotary, without motor, $4.00. Half inch spark coil, $1.75. Good gap for same, 50c. Half kilowatt Blitzen sending transformer, good as new, mounted in home made neat case, $15.00. Reason for selling, buying 1 K.W. set with panel audion receiving. Address Second Presbyterian Church, Don D. Tullis, Pastor, Newark, Ohio.

WANTED—500 watt "Electro" transformer coil with vibrator and condenser, also 43 plate Murdock condenser and "Electro" loading coil. Must be in good condition. Give price. Oscar Scholen, Stanwood, Wash.

FOR SALE—9 volt dynamo motor, 2 volt storage battery, voltmeter, telephone transmitter and receiver, telegraph instruments, $10; American typewriter, good condition, $2.50. George Mapstone, Aurora, N.Y.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the October issue should reach us not later than August 28th.

OVER 70,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N.Y.

BOOKS

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1.50 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 40c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, Ohio.

BOOKS—Scientific and wireless supplied. Let us know what you want and we will quote you. Experimenter Pub. Co., 233 Fulton St., New York City.

A BINDER for THE ELECTRICAL EXPERIMENTER will preserve your copies for all time. Price 50c. Postage on 3 lbs. is extra. Send for one today. Experimenter Pub. Co., 233 Fulton St., New York City.

MISCELLANEOUS

Send two dollars for bar of aluminum solder and flux, use common soldering iron. Satisfaction guaranteed. Fred W. Beitz, 204 E. Armstrong St., Peoria, Ill.

RAZORS, Safety Razors, blades (our specialty), shears, clippers, etc., ground and sharpened. Write for price list. Buffalo Cutlery Co., 29 Grant Street, Buffalo, N.Y.

25 CARDS, your name and address neatly printed on same, 10c. (coin) postpaid. 100, 35c. D. McLean, Printer, 334 Stevens St., Lowell, Mass.

STAMPS.—75, all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

100 NEATLY PRINTED VISITING CARDS 49c. Handsome card case given FREE with each order. Send stamp for samples. The Prudon Specialty Mfg. Co., 921 Demott St., North Bergen, N.J.

FILMS DEVELOPED FREE—Send negative for sample print and particulars. New Lex. Novelty Co., New Lexington, Ohio.

FOR SALE—One 10 H.P.; three 15 H.P.; and one 75 H.P. motors, practically new. Sheip & Vandegrift, Inc., 814 North Lawrence St., Philadelphia, Pa.

MARCONI—We have a limited number of pictures of Guiglielmo Marconi that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each postpaid. Experimenter Publishing Co., 233 Fulton St., N.Y.

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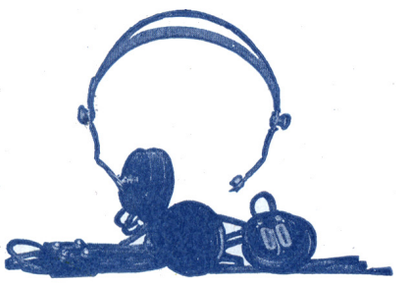

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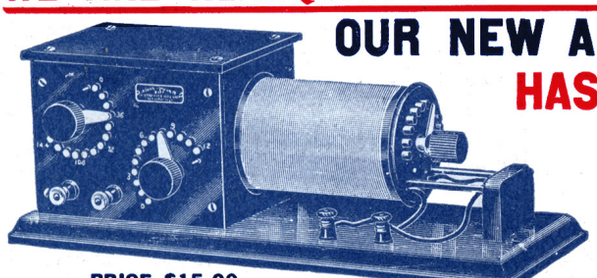

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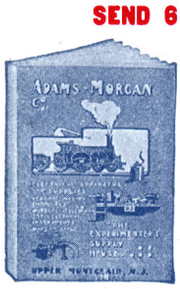

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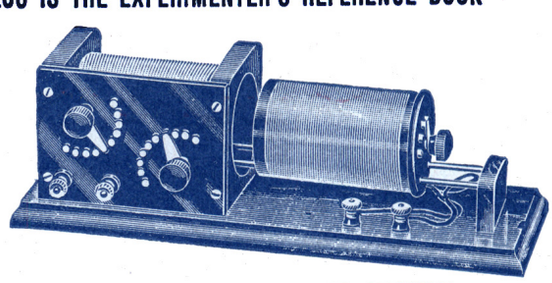

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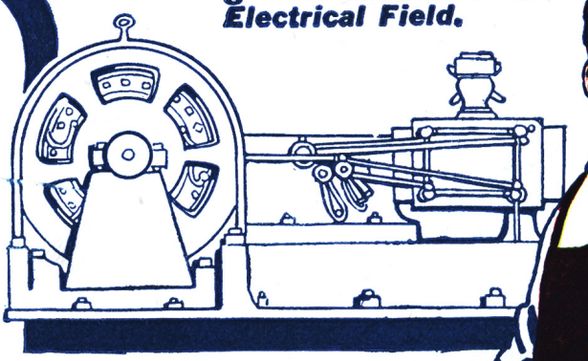

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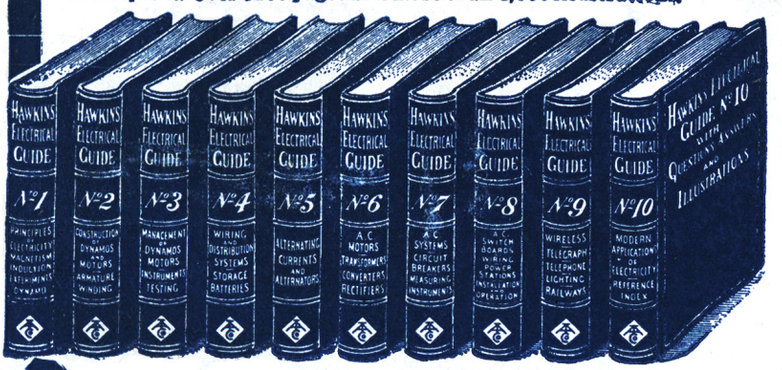

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